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OF

THE ASTRONOMICAL OBSERVATORY OF HARVARD COLLEGE.

VOL. XXVIII.—PART I.

SPECTRA OF BRIGHT STARS

PHOTOGRAPHED WITH THE 11-INCH DRAPER TELESCOPE

AS A PART OF

THE HENRY DRAPER MEMORIAL

AND DISCUSSED BY

ANTONIA C. MAURY

UNDER THE DIRECTION OF

EDWARD C. PICKERING

DIRECTOR OF THE OBSERVATORY

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PREFACE.

One of the first investigations undertaken as a part of the Henry Draper Memorial was the detailed study of the spectra of the bright stars north of declination —30°. This work was assigned to Miss Antonia C. Maury in 1888, and she is alone responsible for the classification contained in Part I. of this volume. A large part of the work of determining wave lengths, and of preparing the volume for publication, has been done by several of the other officers of the Observatory.

As the investigations were made several years ago, they could not take account of the recent discoveries respecting the spectrum of helium, which, if known at the time, might have had an important influence upon some of the conclusions. Such modifications could not now be introduced without practically rewriting the treatise, which is therefore published without change. A discussion of the relation of the spectra of stars of the Orion type to that of helium has, however, been made, and is contained in the "Supplementary Notes," pages 122 to 128.

EDWARD C. PICKERING,
Director of the Observatory of Harvard College.

Cambridge, U. S., *February 18, 1897.*

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SPECTRA OF BRIGHT STARS.

CHAPTER I.

OUTLINE OF CLASSIFICATION.

THE following pages contain the results of an examination of about forty-eight hundred photographs representing the spectra of six hundred and eighty-one of the brightest stars north of declination —30°. The photographs were taken with the apparatus described in Volume XXVI. of these Annals (p. xv). The telescope employed was one originally constructed for visual use by Dr. Draper, but provided with an additional lens to adapt it to photographic purposes. It has an aperture of 11 inches, and a focal length of about 153 inches. Four prisms, each having a refracting angle of about 15°, a deviation of 8°, and a clear aperture of 11 inches, may be placed singly or together in front of the object-glass. The telescope is mounted as an equatorial, and the clockwork driving it is controlled electrically by an auxiliary clock in the photographic laboratory, the rate of which is varied at pleasure by adding or removing weights placed upon the pendulum. The spectrum photographed is accordingly made to traverse the plate in the direction of the spectral lines with any desired speed, in order to widen it sufficiently to make the lines distinct. The rate of this movement was regulated in accordance with the brightness of the star under observation, its color, and the dispersion employed. The time of exposure was usually one hour, but sometimes more. The length of the photographed spectrum between $H\epsilon$ 3970 and $H\beta$ 4861, was 8.0 cm. when four prisms were used together, and 2.0 cm. with one prism only.

Since only the brighter spectra could be photographed when four prisms were employed, a number, selected as typical, were photographed also with two prisms and with one, in order that they might be satisfactorily compared with those of fainter stars, which had not in any case been photographed with the entire number of prisms. The classification of stellar spectra which will be described below depends chiefly upon the comparison of spectra photographed with one prism. Remarks upon the details of the brighter spectra are of course frequently derived from the photographs exhibiting a greater degree of dispersion.

The comparisons themselves were made by placing the photographic films in contact, with the spectra to be compared side by side. The identification of particular lines as common to the two spectra largely depended upon the similarity in intensity, as well as in position, of the great majority of the neighboring lines in the two photographs.

In order to determine the wave lengths of many of the lines in the typical spectra, the solar spectrum was photographed with the 11-inch telescope above described, combined with the Draper 15-inch reflector, used as a collimator in the manner explained on page xvi of Volume XXVI. of these Annals. The relative distances of lines in the solar spectrum, and in various stellar spectra, were determined by means of the measuring apparatus described on page 42 of Volume VIII. of these Annals. This apparatus is provided with two screws placed perpendicular to each other, by means of which the photograph to be measured can be moved under a microscope. One revolution of either screw advances the photograph one twenty-fourth of an inch. The heads of the screws carry graduated circles six inches in diameter, by means of which one thousandth of a revolution may be readily observed.

By means of this instrument, the stellar spectra photographed with four prisms could be compared with the solar spectrum photographed with the same dispersion. In the spectra of the same stars, photographed with a smaller number of prisms, the corresponding lines could readily be identified and compared with those found in the spectra of the fainter stars, in order to determine the place of each star in the system of classification which was finally adopted.

This classification depends, to some extent, as will be seen below, upon the appearance, as well as upon the position of the spectral lines. Care was necessary, therefore, not to confound appearances due to the want of an accurate focal adjustment with those characteristic of particular stars. When the focal adjustment is unsatisfactory, the edges of the lines are ill defined; but when it is improved, while these edges become more definite, the line itself often remains comparatively indistinct, and having relatively little contrast with the remainder of the spectrum. Such lines, in the course of the present treatise, will be described as "hazy."

Care was also required, in deciding upon the character of a photographed spectrum, to make the proper allowance for the degree of density of the silver precipitate. In a photograph somewhat over exposed, the unusual density of the image makes all the lines narrower than they would otherwise be, and may even obliterate fine lines and faint bands. The opposite effect, resulting from insufficient exposure, exaggerates the relative importance of the fainter bands and increases the apparent width of well marked lines.

The comparison of a considerable number of photographs, of apparently good quality, was therefore often requisite to obtain a satisfactory decision with regard to the proper classification of some stars. It was likewise necessary to conduct the investigation systematically, by successively comparing each typical star with those most nearly resembling it in the nature of their spectra, in order to avoid errors in the identification of the lines. Without these precautions many of the finer gradations of the classification would have escaped notice.

In the present treatise, particular lines are designated by their wave lengths, the unit of wave length being the ten-millionth of a millimeter. The extent of a group or of a band of lines is indicated by the statement of the wave lengths of its extreme limits.

The principal terms here to be employed in describing certain well marked classes of lines may require some explanation. The lines of hydrogen form, as is generally known, one of the most important of these classes, and are often mentioned collectively as hydrogen lines. They are mentioned individually, according to the nomenclature of Vogel, as $H\beta$, $H\gamma$, $H\delta$, $H\epsilon$, $H\zeta$, $H\eta$, $H\theta$, $H\iota$, $H\kappa$, $H\lambda$, $H\mu$, $H\nu$, $H\xi$, Ho, $H\pi$, $H\rho$, $H\sigma$, $H\tau$, $H\upsilon$. With these are often associated the lines or bands of calcium, known as H and K, the letter H in this case not referring to hydrogen. The portion of the spectrum containing the line $H\alpha$, due to hydrogen, is not contained in these photographs.

Another class of lines frequently mentioned comprises those which are characteristic of the solar spectrum, excluding the lines of hydrogen and calcium. They are called "solar" lines, except when referring to lines not contained in the solar spectrum, in which case they are called metallic lines.

A third class of lines includes those known as "Orion lines," from the fact that they are conspicuous in the spectra of many stars belonging to the constellation Orion. They are often strongly marked, and generally appear to be single, and not separable into two or more lines by increased dispersion, as is frequently the case with the solar lines.

Certain stars, such as α Cygni and δ Canis Majoris, have spectra in which the majority of the lines, though probably identical in position with lines belonging to the solar spectrum, differ greatly in intensity, while others apparently are not represented in the solar spectrum. The characteristic lines of such stars should perhaps be regarded as forming a class distinct from those already described.

It has long been known that stellar spectra could readily be classified in large groups, ordinarily described as types; and further, that, as is generally the case in natural systems of classification, intermediate varieties could be found between the groups, so that the entire number of spectra observed could be arranged in a series, which has usually been regarded as exhibiting more or less distinctly a course or plan of development. In some parts of this series large numbers of almost identical spectra are found, even when several hundred lines appear in each. The transition of type shown in this series proceeds, as a rule, by barely perceptible degrees, but at times it is more abrupt, the intermediate varieties being fewer.

The method of detailed classification which resulted from the present investigation will now be explained. As usual, the stars were arranged in an apparently progressive series, which in the present case was made to include twenty-two groups, excluding composite spectra, that is, spectra which seemed in reality to result from the combination of the spectra of two or more close components of different spectral characters, and excluding also those in which bright lines were the most important feature. But it also appeared that a single series was inadequate to represent the peculiarities which presented themselves in certain cases, and that it would be more satisfactory to assume the existence of collateral series. These are called "Divisions" in the following pages. They pursue parallel courses of development through at least many of the groups employed, as above stated, to represent stages of progress. The features peculiar to each of these divisions must now be described, before passing to the distinctions made between the various groups.

The chief division, including 355 of the 681 stars examined, was called "Division *a*." In the spectra of this division, none of the single lines, that is, lines which cannot be resolved into pairs or groups by increasing the dispersion, are relatively wide, except those of hydrogen and calcium; and all are clear, that is, as explained above, they are well contrasted with the bright portions of the spectrum, in distinction to the lines which have been called hazy. Good examples of stars belonging to Division *a* are α Lyræ, α Canis Minoris, the Sun, α Boötis, and, among stars remarkable for Orion lines, γ Orionis.

Division *b* comprises stars in the spectra of which all the lines are relatively wide and hazy. As already remarked, this description does not signify any want of definition in the edges of the lines, as compared with those in the spectra of the other divisions, but refers to the appearance of the lines themselves. Owing to this haziness, the fainter lines become altogether imperceptible, and the total number of lines which can be seen is therefore often comparatively small. The relative intensity of those which are visible, however, remains about the same as in spectra of Division *a*, so that there appears to be no decided difference in the constitution of the stars belonging respectively to these two divisions. Indeed, the spectra of the close binary stars, ζ Ursæ Majoris and β Aurigæ, which, when they appear single, belong to Division *a*, pass into Division *b* by the widening of the lines before they become distinctly resolved into pairs. As further examples of stars belonging to Division *b* may be mentioned α Aquilæ, and, among stars containing Orion lines, δ Orionis and α Leonis.

The principal characteristics of Division *c* are, first, the lines of hydrogen are narrow and well defined, and their maximum intensity does not exceed eight tenths of that attained by stars of Divisions *a* and *b*; secondly, the Orion lines are likewise narrow and well defined, and are still discernible in this division in some groups early in the series from which they have disappeared in Divisions *a* and *b*; thirdly, the lines of calcium (except in a single group), are more intense than in the corresponding groups of the other divisions; fourthly, the system of metallic lines contains some apparently not coincident with any lines of the solar spectrum, many of these metallic lines are unusually intense, and the relative intensity of the different lines does not correspond with that observed in the solar spectrum. It has already been mentioned that this system of lines should perhaps be regarded as forming a separate class, as in the case of the Orion lines, and should not be described as "metallic," as has just been done in the absence of any more distinctive name. In general, Division *c* is distinguished by the strongly defined character of its lines, and it seems that stars of this division must differ more decidedly in constitution from those of Division *a* than is the case with those of Division *b*.

As happens with successive groups, it is also found in attempting to assign stars to a particular division, that spectra of intermediate forms occur. A spectrum intermediate between those of two divisions is briefly described by the combination of the two corresponding letters, *ab*, for example, or *ac*. When the spectrum cannot be assigned with certainty to either division, owing to the faintness of the star, or the imperfection of the photographs representing its spectrum, two letters separated by a comma are employed; thus *a*, *b* denotes that the star may belong to either of the divisions *a* or *b*.

Spectra intermediate between Divisions *a* and *c* are almost as numerous as those belonging strictly to Division *c*, and the gradation from the most marked characteristics of Division *c* to spectra closely resembling those typical of Division *a* is particularly apparent in the thirteenth group. The intermediate forms of spectra are valuable aids in determining the groups of Division *c*, which best corresponded to similar groups already formed from spectra of Division *a*.

Before proceeding to the minute description of the peculiarities of the successive groups, a general sketch of the principles according to which they have been formed may be desirable. The first five groups have been formed from stars in the spectra of which the Orion lines are particularly prominent, and which may be called stars of the Orion type. The sixth group contains stars intermediate between this Orion type and the first type of Secchi, to which belong the stars in the seventh to the eleventh groups inclusive. The twelfth group lies between the first and second types of Secchi, and the stars in the thirteenth to the sixteenth groups inclusive belong to this second type. Secchi's third type includes the stars of the seventeenth to the twentieth groups inclusive. The twenty-first and twenty-second groups are respectively coincident with the fourth and fifth types of stellar spectra.

The general course of development traceable through the series is as follows. In the Orion type, the system of hydrogen lines is comparatively faint, and terminates with $H\xi$, the more refrangible hydrogen lines being absent or invisible. The Orion lines are, as has been said, particularly numerous and well marked, while the solar lines, except perhaps those at 4144 and 4481, are absent. Of the calcium lines only K is present and is very faint. In the transition from the Orion type to Secchi's first type, the Orion lines gradually become fainter and less numerous, until in the spectrum of α Canis Majoris, a good example of the first type, all but two or three are wanting. Meanwhile, the solar lines have begun to make their appearance, and in the group containing α Canis Majoris more than one hundred such lines are found, although they are inconspicuous. At this part of the series the hydrogen lines have acquired their maximum intensity, and form the most prominent feature of the spectrum. The system can be traced at least as far as $H\pi$ or $H\rho$. Both the calcium lines are present, and the intensity of the K line has increased.

Stars of the second and third types, as is well known, have spectra in which the solar lines become much more prominent than before. In the spectrum of α Orionis, for example, their number exceeds three hundred in the portion of the spectrum lying between 3970 and 4861, while the region between 4861 and 5900, which is studied by means of plates stained with erythrosin, contains more than one hundred and fifty. The latter region in the early first type stars appears to be almost destitute of lines. Among these earlier groups of third type stars, the collective intensity of the solar lines is at a maximum. In the last two groups of the series, distinct lines give place to extensive bands and flutings.

The relative intensity of the solar lines, as we pass onward from the group of α Canis Majoris, undergoes a change so gradual as to be in general almost imperceptible. It is, however, well marked in the transition from the first to the second type. Certain lines are specially affected. Thus, a marked increase in the group of lines extending from 4299 to 4315 gives rise to the conspicuous band seen in the solar spectrum, and called by Fraunhofer G. Similarly, a compound line having its centre at 4227 becomes a distinguishing feature of third type stars.

The intensity of the calcium lines continues to increase, at first slowly, but with a great and sudden rise as the first type passes into the second. In the early groups of second type stars these lines thus become wide bands having more than twice the intensity of the hydrogen lines of α Canis Majoris. This is well shown in α Aurigæ and the Sun. In the later groups of second type stars the calcium bands attain their maximum intensity. They show no increase and a possible slight decrease in the third type.

The hydrogen lines, on the other hand, after remaining nearly constant in the two groups following that of α Canis Majoris, begin to decrease rapidly in the transition from the first to the second type. Their intensity in stars like α Aurigæ and the Sun is little more than a tenth of that shown in α Canis Majoris. These lines continue to decrease, though less rapidly, down to the third type stars, where they are inconspicuous among the faint solar lines.

The nearly constant relation of the decreasing intensity of the lines of hydrogen to the increasing intensity of the lines of calcium and solar lines is probably the most important law in the sequence of stellar types.

Another important feature of the series is the manifestation of extensive absorption in the later groups of second type stars, and its marked increase in those of the third type. In second type spectra it affects only rays having shorter wave-length than 4307; in those of the third type, it is so conspicuous in the region between 4760 and 5900 as to constitute the distinctive feature of the type. This absorption, spreading unequally over wide areas of the spectrum, causes variations, abrupt or gradual, in the intensity of the light.

The absorption in the region having shorter wave length than 4307 begins generally in the group following the Sun, though, by exception, it occurs in the Sun itself; and, widening from one or two centres, covers at length the entire region.

This, in combination with three bands of increased brightness, having wave lengths approximately from 4614 to 4648, 4470 to 4525, and 4315 to 4368, respectively, causes the second type spectra of the later groups to appear as though they consisted of faint and bright portions separated by the strong band at 4307. The apparent bright bands just mentioned begin to appear in the earliest group of second type spectra, become gradually stronger, and reach their highest intensity in the last group of the second type. They are best seen under small dispersion, since a greater dispersion renders the contrast less marked.

A strong absorption in the ultra-violet causes, in spectra of the group following that of the Sun, an abrupt diminution in the intensity of the light at wave length 3889. This, in transition to the third type, spreads to 3934, and finally to 3970, so that all rays of shorter wave length are difficult to photograph. The fading, however, is here no longer abrupt, but gradual.

The absorption in the region between 4760 and 5900 begins in the first group of third type stars, and becomes more marked in each succeeding group. It shows itself as four strong bands, having their limits of shorter wave length at 4762, 4954, 5168, and 5445, respectively. A fifth, less marked band appears in the last group of the series, having its limit of shorter wave length at 4586. Each of these bands is abrupt and strong on the edge of shorter wave length, and fades gradually toward the succeeding one, so that no definite limit of greater wave length can be given. Each is bordered by a distinct bright band on the edge of shorter wave length. As the absorption bands develop, the bright borders increase in brightness in the successive groups of third type stars. These bands are well shown in *α* Herculis and in variable stars like *o* Ceti.

The three bright bands in the region between 4315 and 4648, mentioned as conspicuous in the later groups of second type stars, fade gradually in the successive groups of third type stars. With the fading of these, the contrast in intensity of light in the portions of the spectrum separated by the band at 4307 diminishes, and in the last group disappears. It may be noted, however, that a bright band 4556 to 4586 develops in third type stars.

The foregoing statement describes the series of spectral types so far as it has been possible to establish it. If, as we are led to conjecture from their color and from the prevalence of extensive absorption in their spectra, stars of the fourth type follow those of the third, the conjecture cannot become a satisfactory theory in the absence of any connecting links indicating the transition from one type to the other. For the present, therefore, we may regard the series as ending with spectra of the third type, and, in particular, with the system of dark lines contained in the spectra of such variables of long periods as *o* Ceti.

In the detailed description of the groups, to be given later, some of the spectra are regarded as intermediate between two groups. In such cases, new groups might, of course, have been established in order to provide for these intermediate spectra. When, however, two groups were closely allied, the intermediate spectra did not seem to require the introduction of such an additional group. But when, between successive groups greatly differing from each other, spectra were found of an intermediate character, they were combined in a new group, even when these spectra themselves presented considerable variety.

Table I. gives a general view of the system of classification above described. Stars, which in the detailed account of the groups, to be given hereafter, are placed between two groups, as just explained, are here assigned to that group which they most closely resemble. In the first column, O., I., II., III., IV., V., C., and L. are used to denote respectively spectra of the Orion type, spectra of the five usual types, composite spectra (apparently to be resolved into two or more), and spectra which are mainly of the Orion type, but contain bright lines. The second column contains the numbers of the groups. The succeeding columns give the numbers of stars belonging to each division in each group, and the total numbers. As Division *c* is distinguished by very narrow, and Division *b* by very wide lines, while those of Division *a* are intermediate, the first of these columns relates to Division *c*; the next to spectra intermediate between Divisions *c* and *a*; those which follow relate respectively to spectra of Division *a*, to spectra which might be assigned either to Division *a* or to Division *b*, to spectra clearly intermediate between these divisions, to spectra of Division *b*, to spectra which might be placed under either of the headings *a*, *b*, or *ac*, and to peculiar spectra, under the heading *p*. The distinction between the use of two letters in juxtaposition and the separation of the same letters by a comma, has been already stated on page 5, where it is also explained that the latter symbol indicates that the photographs employed were inadequate to the satisfactory determination of the division.

It will be observed that stars following the twentieth group are not assigned to particular divisions, and are not considered as having a place in the series exhibiting the gradual development of stellar spectra.

The final column contains letters corresponding to those used in the classification adopted for the Draper Catalogue, in Volume XXVII. of these Annals. A position in the series intermediate between two groups of the Draper Catalogue is indicated by the use of both the letters designating these groups. Small letters following the letters denoting the groups refer to subdivisions of the groups.

It appears from Table I. that spectra of Division *c* are not found in groups following the thirteenth, nor are those placed under the heading *ac* after the fourteenth group, which is that containing the Sun. Spectra of Division *b* disappear still earlier, so that the series tends to become more uniform as it progresses. But this, in so far as it relates to Divisions *a* and *b*, may partly be due to the circumstance that in groups following the eleventh many stars occur not sufficiently bright to allow the use of more than one prism in photographing their spectra. Accordingly, some of these stars may have been assigned to Division *a* merely because the dispersion was insufficient to exhibit the true character of the lines in their spectra.

TABLE I.

CLASSIFICATION OF SPECTRA.

Type.	Group	Division.								Total.	D. C.
		c	*ac*	*a*	*a, b*	*ab*	*b*	*a, b, ac*	*p*		
O.	I.	. .	. .	. .	. .	. .	7	. .	. .	7	B
O.	II.	. .	. .	4	5	. .	5	. .	2	16	B
O.	III.	1	. .	5	7	. .	5	. .	1	19	B
O.	IV.	. .	. .	11	22	3	14	. .	. .	50	B
O.	V.	3	. .	9	8	. .	5	. .	. .	25	A B
O. I.	VI.	6	. .	4	9	3	9	. .	. .	31	A B
I.	VII.	1	. .	13	13	. .	17	. .	1	45	A
I.	VIII.	1	1	23	6	3	17	. .	7	58	A
I.	IX.	. .	. .	?	17	3	9	5	. .	34	A F
I.	X.	. .	. .	2	12	2	3	. .	. .	19	A F
I.	XI.	. .	5	?	11	5	. .	7	1	29	F
I. II	XII.	2	3	29	. .	1	. .	. .	. .	35	F G
II.	XIII.	4	1	22	. .	. .	. .	. .	. .	27	G
II.	XIV.	. .	7	40	. .	. .	. .	. .	3	50	G
II.	XV.	. .	. .	117	. .	. .	. .	. .	1	118	K
II.	XVI.	. .	. .	23	. .	. .	. .	. .	. .	23	K
III.	XVII.	. .	. .	19	. .	. .	. .	. .	. .	19	Ma
III.	XVIII.	. .	. .	20	. .	. .	. .	. .	. .	20	Mb
III.	XIX.	. .	. .	10	. .	. .	. .	. .	. .	10	Mb
III.	XX.	. .	. .	4	. .	. .	. .	. .	2	6	Md
IV.	XXI.	. .	. .	. .	. .	. .	. .	. .	. .	4	Na
V.	XXII.	. .	. .	. .	. .	. .	. .	. .	. .	4	O
C.	—	. .	. .	. .	. .	. .	. .	. .	. .	18	. .
L.	—	. .	. .	. .	. .	. .	. .	. .	. .	14	. .
Totals . . .		18	17	355	110	20	91	12	18	681	

Still, sixty-six stars of these later groups were photographed with more than one prism, and among these no instance was found of a spectrum exhibiting the wide lines of Division *b*, and only one, in the twelfth group, which could properly be placed under the heading *ab*. It is therefore probable that spectra distinctly belonging to Division *b* are confined to stars of the Orion type and of Secchi's first type. Minor peculiarities of individual spectra also suggested the same tendency to an increasing uniformity as the series progressed.

It will also be observed that the peculiar spectra enumerated under the heading *p* occur most frequently in the eighth group, which follows that to which α Canis Majoris belongs, and that only two such spectra occur later than the fourteenth group. Slight variations, affecting only the intensity of a very few lines, were common from the sixth to the fourteenth group inclusive, while beyond this point the spectra of each group, although often containing from 200 to 300 lines, were practically indistinguishable from each other.

While it will be generally admitted that the series represents successive stages in stellar evolution, it may still be doubted whether the arrangement beginning with the Orion type, and here adopted, is in fact the natural order. It is strongly indicated, however, by the gradual falling off of the more refrangible rays in the successive groups, by the corresponding increase in the less refrangible rays, and by the occurrence of marked absorption at the close of the series. The comparative simplicity of the Orion spectra and the increasing complexity shown throughout the series lend additional weight to the argument. Finally, the prevalence of the Orion type in great nebulous regions, as in Orion and the Pleiades, indicates very emphatically that stars of this type are in an early stage of development.

The question whether spectra of the fifth type do not form a connecting link between the Orion spectra and those of the nebulæ was considered in an article entitled "A Fifth Type of Stellar Spectra," published in the Astronomische Nachrichten, Vol. 127, p. 1, and also in a paper on "The Constitution of the Stars," read at the Congress of Astronomy and Astrophysics at Chicago in 1893.

Brief allusion should be made to four classes of stars which, as stated above, are excluded from the general series. The first to be mentioned are those which combine features of widely differing types, and are designated by the letter C in Table I. In these stars it is most common to find the spectrum of the second or third type associated with a hydrogen spectrum that is characteristic of the first type. Some stars of this class, like γ Andromedæ and 31 Cygni, are known doubles, and the strong resemblance which most of the stars in question bear to them suggests that stars with these anomalous spectra may in general be close doubles. In spectra of this class, including those belonging to known doubles, the K line appears either unduly narrow, or overspread with a peculiar haziness. This appears to be due to the presence of an additional star, having a spectrum which belongs to some group earlier in the series. It is also significant that in such spectra the first type characteristics predominate in the ultra-violet, the second or third type features in the green and blue. This is exactly what would happen if two spectra of the first and second type were superposed. Perhaps the most beautiful examples of the composite type found among stars not known doubles are ζ Aurigæ and δ Sagittæ, which combine the second and Orion types, and the third and first types, respectively.

The fourth type stars show a wide band of complete absorption having its edge of greater wave length approximately in the position of the line Hβ. A second absorption band having greater wave length is commonly shown when the photographic spectra are prolonged toward the red by means of plates stained with erythrosin. These absorption bands, unlike those of the third type stars, are abrupt on the edge of greater wave length and fade toward the violet. The spectra of fourth type stars commonly extend but a short way beyond the line Hβ in the direction of shorter wave length. They are, however, prolonged toward the red as far as or beyond the D line, and show several well marked lines near the end of greatest wave length. These have not as yet been identified with lines of other stars. The spectra exhibiting bright lines bear singular relations to the general series. They are naturally divided into three classes. Those of the fifth type, as has been said, possibly form a link between the nebulæ and stars of the Orion type. They show on a faint continuous spectrum ten or twelve wide fuzzy bright bands, most of which coincide with hydrogen lines and important Orion lines of Group I. The strongest of these bright bands, 4688, is probably present also in the spectra of gaseous nebulæ. These coincidences were first noted by Mrs. Fleming in a study of the plates taken with the 8-inch telescope, and they are confirmed by the plates of higher dispersion studied in this investigation. The second class of bright line stars is formed of those having a more or less normal Orion spectrum, in which, however, many of the lines are accompanied by bright bands. The lines thus reversed are generally one or more of the hydrogen lines and of the strong Orion lines. A double reversal is seen in the lines of hydrogen in γ Cassiopeiæ. The intensity of the bright bands is generally greatest in the line Hβ, and decreases with the wave length. In one or two of these stars, notably in β Lyræ, the bright bands cross over the dark ones periodically. This is discussed in the Remarks on Individual Stars.

The third class of bright line stars consists of the long period variables. The system of dark lines in the spectrum of these has been regarded above as showing the last phase in the series. They have the hydrogen lines wholly bright, the maximum brightness being in the line Hδ and decreasing in either direction. The line Hβ, which was brightest among the Orion bright line stars, is often faint or invisible.

It is thus a matter of great interest that the bright line stars are found at the beginning and at the end of the series, and that one class of them probably connects the series with the nebulæ.

CHAPTER II.

Detailed Description of the Classification.

The following pages contain a more detailed description of the groups into which the series has been divided. The division was at first based on barely perceptible differences, but the number of groups thus became inconveniently great, and was accordingly reduced. Since the progressive changes shown in the series consist for the most part in gradual alterations in intensity, all distinctions made in describing the groups must be more or less arbitrary. The attempt has been made, however, to select the most constant and obvious features as a means of separating, as clearly as may be, each group from the two adjacent ones.

In describing each group, the typical star or stars have been given in paragraph I., the distinguishing features of the group in II., and the further description in III.

The descriptions relate generally to stars of Division *a*. They have, however, been supplemented by statements of the differences shown in Divisions *b* and *c* as compared with Division *a*. Stars intermediate between Divisions *a* and *b* or *a* and *c*, occurring in some groups, are denoted by the designations *ab* and *ac* respectively, and described in supplementary statements. The peculiarities of individual stars have been considered in the series of remarks at the end of this treatise. Tables IX., X., and XI. contain lists of stars belonging to the successive groups.

In all the descriptions and estimates of what is called the intensity of the lines, the width of each line, as well as the contrast between it and the adjacent portions of the spectrum, has been considered as a mark of intensity.

Before passing to the descriptions, it may be noted that, in dividing the Orion stars into groups, it has been found convenient to consider the distribution and relative intensity of certain lines grouped about $H\delta$, whose wave lengths are 4069.4, 4072.0, 4075.9, 4089.2, 4096.9, 4116.2, 4120.5, 4128.5, 4131.4, and 4144.0. The relative intensities of the Orion line 4471.8 and the line 4481.4, which latter may be common to the Orion and solar systems, and increases in intensity as we advance in the series, have also been employed as a basis of classification. The Orion line 4026.4, as being the most constant and as a rule the strongest of the Orion lines, has in many cases been used as a standard for comparing intensities. The hydrogen lines attain their greatest intensity in the group of which α Canis Majoris is the typical star. This intensity has therefore similarly been adopted as a standard of comparison for hydrogen lines. The discussion of the groups is preceded by a tabulation showing their relation to the established spectral types, and the constant features of these types.

Tabulation of Groups in Regard to Type.

Groups I.—V. Stars of Orion Type.

Orion lines strong, numerous, declining in the later groups. Hydrogen lines of moderate intensity, increasing toward the first type. Solar lines absent, unless the lines 4144.0 and 4481.4 are common to the two systems. K line faint; the calcium line, H, absent except in some stars of Division *c*.

Group VI. Stars intermediate between the Orion and First Types.

Groups VII.—XI. Stars of Secchi's First Type.

Orion lines in general absent, except two. Hydrogen lines at maximum intensity, declining in the last two groups. Solar and calcium lines increasing toward the second type.

Group XII. Stars intermediate between First and Second Types.

Groups XIII.—XVI. Stars of Secchi's Second Type.

Hydrogen lines not very strong and growing fainter. Solar lines extremely numerous and increasing. Calcium lines seen as bands, which are strong and gradually increasing.

Groups XVII.—XX. Stars of Secchi's Third Type.

Hydrogen lines weak, bright in Group XX. Solar lines slightly increasing, then declining. Calcium lines strong, slightly decreasing. Bands and flutings replacing lines. The former fading in the direction of greater wave length.

Group XXI. Stars of Secchi's Fourth Type.

Two absorption bands present. Line absorption slight. Blue portion of the spectrum generally very faint.

Group XXII. Stars of Fifth Type.

Wide, bright bands superposed on a faint continuous spectrum, the strongest one of these probably coincident with a bright band in the spectrum of the gaseous nebulæ, and most of the others probably coincident with hydrogen lines and prominent Orion lines.

Remaining Classes of Spectra: —

1. Composite spectra, probably of double stars.
2. Stars of Orion type having bright lines.

GROUP I.

I. Typical stars, ι Orionis, S Monocerotis.

II. Distinguishing features of the group.

1. Lines 4200.3, 4542.7, and 4685.4 have great intensity, being about half as strong as line 4026.4.

2. Among the lines grouped on either side of Hδ the collective intensity is greater on the side of shorter wave length. Line 4089.2 is very strong, and 4096.9 is of considerable intensity, and stronger than in the following groups. Lines 4069.4, 4075.9, 4116.2, and 4120.5 are weak, and often absent or indistinctly visible.

III. Further description.

1. All the stars which have as yet been found in this group are of Division *b*, having wide and hazy lines.

2. In this group, as in Division *b* of most other Orion groups, lines 3964.6 and 4641.1 are absent.

The entire number of Orion lines, however, is nearly the same as in Division *b* of Group II. These lines are given in Table IV. In relative intensity they resemble the lines of Group II., except in the case of the lines described above, and in that of lines 4009.5, 4387.8, and 4649.2, which are much less intense in this group.

3. Except line 4144.0, which is perhaps common to the Orion and solar classes, no solar lines are present.

4. The hydrogen lines, as frequently happens in Division *b*, are strong and very wide. As in the next group, the system terminates with line Hξ, which has greater intensity than line Hν, thus forming an exception to the rule that at the close of the system each successive hydrogen line of shorter wave length declines in intensity.

5. Of the calcium lines K alone is present, and is very faint.

6. The space between the hydrogen lines Hκ and Hλ appears almost like a bright band. A similar but less marked increase of brightness is visible in the region of Hδ, and as far as 4026 or beyond.

This group of Orion stars is of special interest, as being that which appears to be most closely related to the fifth type stars, and through them to the planetary nebulæ. The three lines 4200.3, 4542.7, and 4685.4, described above as characteristically strong in this group, are probably identical with three important bright bands seen in the fifth type stars. A reference to the description of Group XXII. will show that all but two of the lines of the fifth type stars studied in this investigation are probably coincident with lines of Group I.

The system of dark lines in the spectrum of θ Orionis, H. P. 1023, on which the spectrum of the nebula of Orion is superposed, belongs to this group.

GROUP II.

I. Typical stars, ε and κ Orionis.

II. Distinguishing features of the group.

1. Among the lines grouped about Hδ, the aggregate intensities are about the same on either side of this line. Line 4089.2 is the strongest, and has as great intensity as line 4026.4. Line 4116.2 is the second in intensity. The lines 4069.4, 4072.0, 4075.9, 4096.9, 4120.5, and 4144.0 are present, as in the preceding group, but have greater intensity.

2. In the region between Hβ and Hγ, lines 4471.8 and 4649.2 are very prominent. The former is about as strong as line 4026.4; the latter is stronger than line 4026.4, and often as wide as Hβ. Other lines in this region are comparatively weak.

III. Further description.

1. The complete list of Orion lines found in Division *a* of this group, together with rough estimates of their intensities, is given in Table IV. They number about seventy. The presence of the extreme ultra-violet lines 3584 and 3634 is of interest.

2. Except the lines 4144.0 and 4481.4, which may be common to the Orion and solar types, no solar lines are present. The faintness of 4481.4 is noteworthy.

3. The hydrogen lines, as shown in Division *a* of this group, have an average intensity of about two tenths that of the hydrogen lines of α Canis Majoris. As in Group I., the system ends with Hξ which is stronger than Hν.

4. Of the calcium lines K alone is present, and is very faint.

5. The space between the hydrogen lines Hκ and Hλ is nearly as bright as in the preceding group, and so also is the region from 4026.4 to 4144.0.

Of the stars ε and κ Orionis, which were selected as typical of Division *a* in this group, it should be stated that their more prominent lines show in a slight degree the haziness so conspicuous in stars of Division *b*. Whether this is true in general of stars in Group II. cannot be decided, as no other stars of Division *a* have been photographed with four prisms.

GROUP II. — DIVISION *b*.

I. Typical star, δ Orionis.

II. Differences as compared with Division *a*.

1. All lines are wide and hazy.

2. This is especially marked in the lines of hydrogen. Owing to the increase of width, their intensity is greater than in Division *a*, and is about three or four tenths that shown in α Canis Majoris.

3. The faint lines of Division *a* appear fainter in Division *b*, and the faintest are lost. The number of lines is therefore much reduced, being only about thirty-three. These are given in Table IV. Lines 3964.6 and 4641.1, well marked in Division *a*, are absent.

4. The intensity of line 4685.4, and in a less degree that of 4200.3, exceeds that given in the table for Division *a*. On the other hand, the intensity of line 4009.5 is less than in Division *a*. It will be noticed that in these respects Division *b* of Group II. approaches Group I.

GROUP III.

I. Typical star, β Canis Majoris.

II. Distinguishing features of the group.

1. Among the lines grouped about Hδ the aggregate intensity is greater on the side of greater wave length. Lines 4120.5 and 4144.0, which have at least double the intensity shown in the preceding group, are now the strongest lines in this region. They are approximately equal in intensity. All the remaining lines near Hδ have become rather fine. These include all those found near Hδ in the preceding group, and several new faint ones.

2. Line 4649.2, though still conspicuous, has little more than half its former intensity, and is about six tenths as strong as line 4026.4. Line 4387.8, formerly weak, has now more than half the intensity of line 4026.4.

III. Further description.

1. The Orion lines found in this group are about eighty in number. They include nearly all those of the preceding group, and several new ones. These lines with their estimated intensities are given in Table IV.

2. The only lines of this group which may be solar are 4144.0 and 4481.4. Line 4481.4 is still very faint.

3. The hydrogen lines are a little stronger than in the preceding group. They have from three to four tenths the intensity of those of α Canis Majoris. The system still terminates with Hξ, which is stronger than Hν.

4. The K line is faint, as in the preceding groups, and the calcium line H is absent.

5. The increased brilliancy seen in the preceding groups between Hκ and Hλ, and about Hδ, has not been observed in this group, except in one or two stars of Division *b*.

GROUP III. — DIVISION *b*.

I. Typical star, α Virginis.

II. Differences as compared with Division *a*.

1. The lines are hazy, and more or less wide. The principal lines sometimes appear with a ragged and hazy border on one side. (See Remark 18 on α Virginis, in which star this appearance is probably due to the lines of a rapidly moving companion.)

In general, the lines are not as wide as in Division *b* of other Orion groups.

2. In some at least of the stars of this division, nearly all the lines of Division *a* are present. The number of lines lost, however, probably varies with the degree of widening of the lines.

Several additional lines were found in the region between 4861 and 5900 on plates of α Virginis stained with erythrosin. For the lines of Group III., Division *b*, see Table IV.

GROUP III. — DIVISION *c*.

I. Typical star, χ^2 Orionis.

II. Differences as compared with Division *a*.

1. All lines are exceedingly narrow and sharp.

2. The lines of hydrogen have barely one tenth the intensity of those of α Canis Majoris.

3. The K line, as generally happens in Orion stars of Division *c*, is much stronger than in Division *a*. Here it has more than half the intensity of the line 4026.4.

4. Lines 3805.1, 3856.2, 3994.9, and 4154.7 have also a comparatively great intensity. This also is common among Orion stars of Division *c*.

The above named star is the only one so far found in this group belonging to Division *c*. As this star is faint, and the photographs consequently imperfect, the exact relations of the lines grouped about Hδ could not be determined. The lines observed are given in Table IV.

GROUP IV.

I. Typical star, γ Orionis.

II. Distinguishing features of the group.

1. Of the lines which in the preceding groups were found near Hδ on the side of shorter wave length, the triple line 4069.4, 4072.0, 4075.9, is alone clearly visible. It appears as three fine lines. On the side of greater wave length, lines 4120.5 and 4144.0 are still conspicuous, but the former has now only half the intensity of the latter. The line 4116.2 of the preceding group is absent.

2. Line 4367.4 is characteristically strong among the fainter lines.

III. Further description.

1. The Orion lines present are about seventy in number, and for the most part the same as in the two preceding groups. These lines with their intensities are given in Table IV. The presence of the extreme ultra-violet lines 3584 and 3684 is of interest.

2. Lines of this group which may also appear in the solar spectrum are 4144.0 and 4481.4. A slight increase in the intensity of 4481.4 indicates an advance toward stars of the first type.

3. The hydrogen lines have an average intensity from four to five tenths of that in *α* Canis Majoris. The line Hξ is still stronger than Hν, and Ho has not been distinctly seen.

4. The K line is a little stronger than in the preceding groups.

GROUP IV. — DIVISION *b*.

I. Typical star, η Ursæ Majoris.

II. Differences as compared with Division *a*.

1. All lines are wide and hazy.

2. The hydrogen lines in particular are very wide, and nearly as strong as those of *α* Canis Majoris. Their haziness is slight.

3. All the fainter lines of Division *a* are lost. Next to those of Group VI., Division *b*, the stars here described have the smallest number of lines of any stars in the series. These lines are given in Table IV.

4. The difference between the intensity of the hydrogen lines and that of the remaining lines of the spectrum is greater than in Division *a*.

STARS INTERMEDIATE BETWEEN GROUPS IV. AND V.

Stars are found both in Divisions *a* and *b* whose characteristics are intermediate between Groups IV. and V. In such stars the lines 4128.5, 4131.4, and 4481.4, transitional between the Orion and first types, are stronger than in Group IV. proper, and can be seen even in plates taken with only one prism. The first two then appear as a single line. In typical stars of Group IV. the pair of lines 4128.5 and 4131.4 are faintly seen under the highest dispersion, but neither they nor 4481.4 are commonly seen in plates taken with one prism. When these intermediate stars are of Division *b*, the lines in question, and also the triple line 4069.4, 4072.0, and 4075.9

are commonly seen as hazy and broken lines only, and one or other of them may not be visible.

A few of these stars lying between Groups IV. and V. are of Division *ab*, since their lines are but slightly hazy.

GROUP V.

I. Typical star, η Tauri.

II. Distinguishing features of the group.

1. Among the lines grouped near Hδ on the side of greater wave length, the nearly equal pair 4128.5 and 4131.4 have a combined intensity greater than that of line 4120.5, but less than that of 4144.0. The lines seen in the preceding groups near Hδ on the side of shorter wave length have not been seen in stars of this group.

2. The line 4481.4, probably solar, has upwards of five tenths or more of the intensity of the Orion line 4471.8, but is never equal to that line.

III. Further description.

1. The Orion lines are greatly reduced in number, and with but few exceptions have much less intensity than in the preceding groups. Line 3856.2 has now become the strongest line between Hζ and Hη. These with their estimated intensities are given in Table IV.

2. The lines of this group which may be coincident with solar lines are 4144.0 and 4481.4.

3. The intensity of the lines of hydrogen has greatly increased. It averages nine tenths that shown in α Canis Majoris. The line Hο is now present, and the more refrangible lines of the system show gradual decrease.

4. The K line is stronger than in the preceding group, but, except in Division *c*, the other calcium line is probably absent.

Most of the stars in the Pleiades belong to this or the following group.

GROUP V. — DIVISION *b*.

I. Typical star, τ Orionis.

II. Differences as compared with Division *a*.

The hydrogen lines are wider, and the Orion lines are hazy.

All the lines of Division *a* are found in these stars.

GROUP V. — DIVISION *c*.

I. Typical star, η Canis Majoris.

II. Differences as compared with Division *a*.

1. The lines of hydrogen are sharp and narrow. Their intensity is about four or five tenths of that shown in *α* Canis Majoris.

2. The K line is much stronger than in Division *a*. It is nearly equal to that of *α* Canis Majoris. The other calcium line is probably present, though it could not be separated from H*ε*.

3. The Orion lines have as a rule greater intensity than in Division *a*. Their wave lengths are given in Table IV.

This increased intensity of Orion and calcium lines is characteristic of stars of Division *c* in all the Orion groups, as well as in the group of *α* Canis Majoris.

The lines 3856.2 and 3863.2, so conspicuous in stars of the next group belonging to Division *c*, have here also an intensity exceeding that seen in stars of Division *a*.

GROUP VI.

I. Typical star, *β* Persei.

II. Distinguishing features of the group.

1. Each line of the pair 4128.5 and 4131.4 is as strong as line 4144.0, or even stronger.

2. The transitional line 4481.4 has an intensity equal to, but not far exceeding, that of the Orion line 4471.8.

3. The Orion lines 3819.2, 4026.4, 4387.8, and 4471.8 are always present, the second and fourth of these being well marked. Line 4009.5 may or may not be found.

III. Further description.

1. The Orion lines, as may be seen from Table IV., are greatly reduced both in number and intensity as compared with those of the early groups. The maximum number found is nineteen, including those which may be solar. All are faint, except 3819.2, 4026.4, 4471.8, and the transitional lines 4128.5, 4131.4, and 4481.4, which have moderate intensity.

2. The number of solar lines varies from about twenty-five to forty-five. It is smallest in those stars which in the intensity of their Orion lines approach the preceding group.

The solar lines present are as a rule those strongest in *α* Canis Majoris, the typical star of the next group. The entire list is given in Table V.

3. The hydrogen lines are nearly or quite as strong as those of *α* Canis Majoris, and, as in that star, a slight absorption is visible, spreading for some distance beyond their borders. In stars of Division *a*, H*o* is included among the hydrogen lines visible.

In Division *c*, the system extends to Hσ, possibly to Hυ. The decline in intensity at the close of the system is regular.

4. The K line has a greater intensity than line 4026.4, but is not as strong as in α Canis Majoris. The other calcium line is present, though not always separable from Hε.

This group is important as showing the transition from the Orion type to the first type of Secchi. The stars contained in the group show various degrees of resemblance to those of Secchi's first type, being more like the latter in proportion as they lose the characteristics of the Orion type.

If we compare successively γ Orionis of Group IV., β Tauri and β Persei of Group VI., and α Canis Majoris of Group VII., we shall see the gradual disappearance of the Orion lines, and the accompanying development of solar lines.

GROUP VI. — DIVISION *b*.

I. Typical star, α Leonis.

II. Differences as compared with Division *a*.

1. All the lines are very wide. Those of hydrogen are more or less hazy, and the remaining lines of the spectrum are very faint, owing to haziness.

2. Except those of hydrogen nearly all the lines of Division *a* are lost. The only lines commonly shown in addition to the hydrogen and K lines are 3819.2, 4026.4, 4144.0, 4387.8, 4471.8, 4925.7, and the lines 4128.5, 4131.4, and 4481.4, whose increase marks the transition to the first type. Stars of this class have the minimum number of lines found in any stars included in the series. These lines are given in Table V.

GROUP VI. — DIVISION *c*.

I. Typical star, β Orionis.

II. Differences as compared with Division *a*.

1. All lines, including those of hydrogen, are extremely narrow. The intensity of the latter is only about four tenths that seen in α Canis Majoris, and there is no absorption spreading beyond the borders. Hydrogen lines include Hσ, and possibly Hτ and Hυ. This gives seventeen at least, the maximum number found in any star in the course of this investigation.

2. The K line is as strong as in stars of Group VII. belonging to Division *a*, and the other calcium line, which has a somewhat smaller intensity, is distinctly seen separate from Hε.

3. The Orion lines are, as a rule, stronger than in Division *a*. The lines 3854.2, 3856.2, and 3863.2 are conspicuously strong in the ultra-violet. The list of those present is given in Table IV.

4. The metallic lines are fewer than in Division *a*. They consist of the strongest lines found in Group VII., Division *c*. Their wave lengths and intensities are given in Table VII.

GROUP VII.

I. Typical stars, α Canis Majoris and α Lyræ.

II. Distinguishing features of the group.

1. Orion lines, except the two which may be solar and the transitional pair 4128.5 and 4131.4, are absent in typical stars. A trace of line 4471.8, however, is found in α Lyræ.

2. Solar lines are numerous but faint, the one at 4481.4 being the only one clearly shown in photographs taken with one prism.

3. The intensity of the line K does not much exceed one tenth that of the line Hδ.

III. Further description.

1. The lines of hydrogen are at their maximum intensity, and strongly predominant over all other lines. They are accompanied by a slight absorption spreading beyond their borders, yet leaving the borders well defined. The series includes Hπ, and probably Hρ.

2. In α Canis Majoris more than one hundred and thirty solar lines have been found, over a hundred of which lie between Hβ and Hη. In α Lyræ the number is smaller, and this doubtless varies in different stars of the group.

The lines found in α Canis Majoris with their estimated intensities, are given in Table V.

3. Both lines of calcium are present, and the H line is easily separable from Hε in photographs taken with three or four prisms.

A number of stars have been included in this group which approach the preceding in having line 4026.4 clearly present, and yet agree with α Canis Majoris in the intensity of their solar lines.

GROUP VII. — DIVISION *b*.

I. Typical stars, ζ Aquilæ and ο Herculis.

II. Differences as compared with Division *a*.

1. All lines are wide: K and the solar lines are hazy.

2. The fainter lines of Division *a* are lost.

The Orion line 4026.4 is very frequently present, and is often well marked.

GROUP VII. — DIVISION *c*.

I. Typical star, η Leonis.

II. Differences as compared with Division *a*.

1. The hydrogen lines are narrow, and have only seven or eight tenths the intensity of those of Sirius.

2. The metallic lines present are the strong lines of α Cygni of Group VIII., Division *c*, and their relative intensity resembles that shown in α Cygni, and differs from that shown in α Canis Majoris. These lines in general are stronger than those of stars of this group which belong to Division *a*.

3. The Orion lines are more persistent than in Division *a*. Thus lines 4026.4 and 4471.8 are well marked in the typical stars, while 4009.5, 4267.4, and 4387.8 are seen in stars which approach the preceding group. The two lines which may be common to the solar and Orion systems, and which appeared in Division *a*, are also well marked.

4. The intensity of the K line is probably a little greater than in Division *a*.

These stars form an interesting connecting link between the Orion stars having narrow lines, and those stars of the first and second type belonging to Division *c*, which differ so widely from stars of Division *a*. As compared with β Orionis of Group VI., Division *c*, and α Cygni of Group VIII., Division *c*, the typical star of this group, η Leonis, is intermediate in regard to metallic, Orion, and calcium lines, while in regard to its hydrogen spectrum it exceeds both, thus marking the maximum hydrogen intensity for the entire series of stars belonging to Division *c*.

This connection is the more fully established, because the remaining stars included in this group, notably H. P. 551, do not closely resemble the typical star, but in respect to hydrogen, Orion, and metallic lines are intermediate between it and β Orionis of Group VI., Division *c*.

The Orion lines of the typical star η Leonis, and those of the intermediate star H. P. 551, are given in separate columns in Table IV., and the metallic lines of each, with estimated intensities, may be found in Table VII.

GROUP VIII.

I. Typical star, α Geminorum.

II. Distinguishing features of the group.

1. The intensity of the K line is approximately two tenths that of Hδ.

2. The solar lines are stronger than in α Canis Majoris, and somewhat more numerous. In addition to the line 4481.4, seen in the preceding group, line 4549.7, and the band containing lines 4172.3, 4173.6, 4177.8, and 4179.5, and several other bands, can be seen in the plates taken with one prism.

III. Further description.

1. The lines of hydrogen are nearly, if not quite, equal to those of α Canis Majoris, and like the latter are accompanied by slight absorption spreading beyond their borders. The system extends at least to Ho.

2. One hundred and thirty solar lines were found between Hβ and Hη. These include, with several slight exceptions, all the lines in α Canis Majoris found in the regions covered by the photographs of both stars, together with a few additional lines.

The relative intensity of the lines in this group differs but little from that shown in the preceding group, such differences as occur showing an approach to the following groups.

The increase in general intensity, as well as in the number of lines, may be seen from Table V.

GROUP VIII. — DIVISION *b*.

I. Typical star, γ Ursæ Majoris.

II. Differences as compared with Division *a*.

1. All lines are wide and hazy, and the fainter lines of Division *a* are lost.

The width of the lines varies greatly in different stars, and the number of fine lines disappearing varies with the width of the lines in general.

2. The K line, owing to this widening, often appears to have an intensity greater than that in Division *a*. It is often estimated as having four tenths or more the intensity of Hδ.

For this reason stars of Division *b* belonging to this group are difficult to separate from those of Group IX. They may generally, however, be known by the smaller number of lines.

The differences seen in this division as compared with Division *a* are exactly paralleled by the changes undergone by the close binaries ζ Ursæ Majoris and β Aurigæ. These stars, which when their spectra appear single are typical stars of Group VIII., Division *a*, become just before doubling typical stars of Group VIII., Division *b*. In the latter phase, they show not only the wide and hazy appearance of all the lines, together with loss of the fainter ones, but also, frequently, the apparent increase in the intensity of the K line. A good photograph of ζ Ursæ Majoris, taken in this phase, gave the intensity of the K line as seven tenths that of Hδ, and only fifty-eight solar lines in place of one hundred and ten shown when the spectrum was single.

GROUP VIII. — DIVISION *c*.

I. Typical star, *α* Cygni.

II. Differences as compared with Division *a*.

1. The lines of hydrogen are narrow and unaccompanied by absorption spreading beyond their borders. Their intensity is estimated at five tenths that of the hydrogen lines of *α* Canis Majoris, or about half that shown in Division *a*.

2. The relative intensity of the metallic lines is unlike that shown in Division *a*, and resembles that found in Division *c* of other groups. Also, the wave lengths of the lines are not in all cases identical in the two divisions.

One hundred and thirty lines were found between Hβ and Hη, and seventeen beyond Hβ. Those between Hβ and Hη appear with their estimated intensities in Table VII. It will be seen that strong lines are here more abundant than in Division *a*.

3. The calcium lines have about the same actual intensity as in Division *a*; their ratio to the hydrogen lines is, however, of course greater.

α Cygni is the only star as yet found belonging to Division *c* in Group VIII.

STARS INTERMEDIATE BETWEEN GROUPS VIII. AND IX., DIVISION *ac*.

I. Typical star, *τ* Argus.

II. Differences as compared with Division *a*.

The lines of hydrogen have about eight tenths the intensity of those of *α* Canis Majoris. This is intermediate between the intensities of these lines in Divisions *a* and *c* at this point in the series.

The metallic lines present appear to be identical with those of *α* Cygni of Group VIII., Division *c*. Fifty of these lines were found in the rather faint photographs of *τ* Argus taken with two prisms, and they include all the principal metallic lines found in similar photographs of *α* Cygni. The relative intensity also of these lines appears to be exactly the same as in *α* Cygni. The actual intensity may be a little greater, but this is uncertain, owing to the faintness of the image.

The K line has between three and four tenths the intensity of Hδ.

τ Argus is the only star found at this point in the series having a spectrum intermediate between Divisions *a* and *c*.

Group IX.

I. Typical star, α Piscis Austrini.

II. Distinguishing features of the group.

1. The K line has from four to eight tenths the intensity of $H\delta$.

2. The aggregate intensity of the solar lines is greater than in the preceding group, and lines are numerous and well marked in the plates taken with one prism.

III. Further description.

1. The lines of hydrogen are still very strong. Their intensity is estimated at ninety-five hundredths of that seen in α Canis Majoris.

2. The solar lines present are mainly those of the preceding group, with the addition of a few belonging to the groups following. Since, however, the lines of the few stars in this group bright enough to be photographed with four prisms were all more or less wide, the maximum number of lines found was not quite as great as in the preceding group. α Piscis Austrini, which belongs to Division *ab*, was chosen as the typical star of the group, because it most nearly resembled stars of Division *a* in regard to the width of its lines. The general intensity of the solar lines is greater than in the preceding group, and a few slight changes in relative intensity show advance toward the second type. The lines found in α Piscis Austrini of this group are given in Table II. They could not be introduced into the general table of solar lines, because the slight widening rendered it difficult to compare them with the lines of stars belonging to Division *a*. This group is an arbitrary one, and contains stars showing various phases intermediate between the preceding and the following group.

TABLE II.

WAVE LENGTHS OF LINES IN SPECTRUM OF α PISCIS AUSTRINI.

3850.0	3923.0	4024.8	4122.8	4187.6	4260.5	4370.0	4455.0	⎡4554.2
3856.5	3933.8	4030.8	4128.1	4191.8	4271.7	4374.7	4469.5	⎣4556.0
3863.9	3945.2	4041.5	4131.4	4195.6	4275.0	⎡4383.7	4481.4	4558.9
3865.7	3949.0	4045.9	4143.9	4198.5	4282.9	⎣4385.2	4490.0	4564.0
3872.7	3953.0	4048.9	4149.5	4202.2	4289.9	4391.2	4491.6	4572.2
3878.5	3956.6	4054.0	4150.5	4215.7	4297.1	4395.3	4501.5	4584.0
3889.1	3961.6	4057.6	⎡4154.1	4227.0	4299.2	⎡4400.2	4508.5	4588.4
3900.7	3970.2	4063.7	⎣4154.9	4233.6	4302.6	⎣4401.6	4515.4	4619.2
3903.1	3997.6	4067.0	4156.7	4239.0	4308.0	4405.0	4520.3	4629.9
3905.6	4003.0	4071.9	4167.5	4242.5	4315.2	⎡4415.3	4522.9	4635.3
3913.6	4005.3	4077.9	4172.3	⎡4247.3	4321.0	⎣4417.9	4528.8	4647.6
3914.5	4012.6	4035.4	4173.6	⎣4248.7	4326.0	4435.2	4534.2	4657.0
3916.4	⎡4017.4	4101.8	⎡4177.8	4251.0	4340.7	4444.0	4541.6	4668.0
3920.4	⎣4018.4	4118.9	⎣4179.5	4254.5	4352.0	4450.6	4549.7	4703.1

GROUP IX. — DIVISION *b*.

I Typical star, δ Ursæ Majoris.

II. Differences as compared with Division *a*.

All lines are wide; all except those of hydrogen are hazy, and the fainter lines of Division *a* are lost.

GROUP X.

I. Typical star, β Trianguli.

II. Distinguishing features of the group.

1. The intensity of the calcium and hydrogen lines is approximately equal.

The group has been made to include all stars in which the K line has from nine to eleven tenths the intensity of Hδ.

2. The intensity of the compound line H and Hε is greater than that of K.

III. Further description.

1. The intensity of the lines of hydrogen is beginning to diminish. It is estimated at nine tenths that shown in α Canis Majoris.

2. The number of solar lines present is not definitely known, because none of the stars of this group are bright enough to be photographed with four prisms. Photographs of these stars taken with one and two prisms show all the lines seen in stars of the preceding groups under similar dispersion, and some additional ones of the groups following.

The general intensity of the solar lines is a little greater than in the preceding group. A few slight changes in relative intensity show advance toward the second type. In number and intensity the lines may be assumed as intermediate between those of Groups VIII. and XII., which are given in Table V.

GROUP X. — DIVISION *b*.

I. Typical star, α Aquilæ.

II. Differences as compared with Division *a*.

All lines are very wide, and the solar lines are hazy. The number of lines is considerably less than in Division *a*. The typical star, however, contains nearly all the lines found in α Piscis Austrini of Group IX., Division *ab*.

In the case of the majority of the stars contained in this group, it has not been found possible to decide whether they belong to Division *a* or *b*, as they have not been photographed with sufficient dispersion to determine the width of their lines.

GROUP XI.

I. Typical star, δ Aquilæ.

II. Distinguishing features of the group.

1. The intensity of the calcium lines exceeds that of the hydrogen lines. The K line has from fifteen to twenty-five tenths the intensity of Hδ.

2. The intensities of K and the compound line H and Hε are approximately equal. In most stars of the group, K slightly exceeds the other line.

3. In the plates taken with one prism the band at 4307 (Fraunhofer's G) does not appear, except that the compound line 4299.2–4302.6 included in it is visible as in the preceding group.

III. Further description.

1. The lines of hydrogen have about seven tenths of the intensity of those in α Canis Majoris.

2. The solar lines in this group are nearly identical with those in Group XII., as regards number and intensity, except that the lines between wave lengths 4299.2 and 4315.2 in stars of the second type, and forming the G band of Fraunhofer, and also line 4326.0 are much weaker in this group. The general intensity of solar lines is slightly greater than that in the preceding group.

The majority of stars included in this group, owing to insufficient dispersion, cannot be assigned with certainty to Divisions *a* or *b*, and among the few which were photographed with four prisms none were of Division *a*. This group, like the preceding, is a somewhat arbitrary one, and shows a number of intermediate phases.

GROUP XI. — DIVISION *ab*.

I. Typical stars, γ Boötis and γ Virginis.

II. Differences as compared with Division *a*.

The lines are but little wider than those of stars belonging to Division *a*. The spectra seem nearly to agree with stars of Group XII., Division *ab* in the number and intensity of the lines present, except in regard to the band at 4307, and the lines of hydrogen and calcium. The only stars of the group that have been photographed with four prisms belong to Division *ab*.

GROUP XI. — DIVISION *ac*.

I. Typical star, 22 Andromedæ.

II. Differences as compared with Division *a*.

The intensity of the metallic lines is intermediate between the intensities of the lines of Divisions *a* and *c*.

In the plates taken with a single prism these differences show themselves only in a somewhat increased intensity in certain lines as compared with those of Division *a*.

They are most easily recognized by the greater intensity of line 4417.9, which appears to coalesce with 4415.3.

Only two stars of this intermediate division were found which properly fall into this group. They were too faint to be photographed with four prisms.

STARS INTERMEDIATE BETWEEN GROUPS XI. AND XII. — DIVISION *a* OR *b*.

A number of stars are found intermediate between Groups XI. and XII.

In these the K line has about three and five tenths times the intensity of the line Hδ, and slightly exceeds that of the compound line H and Hε. The hydrogen lines have about four tenths the intensity of those of α Canis Majoris. The intensity of the solar lines is intermediate between the two groups, and a trace of the band at 4307 is commonly seen in photographs taken with one prism.

STARS INTERMEDIATE BETWEEN GROUPS XI. AND XII. — DIVISION *ac*.

I. Typical star, α Leporis.

Among those stars which are intermediate between Groups XI. and XII., several are found whose metallic lines are of a character intermediate between those of Divisions *a* and *c*.

In α Leporis, the only one of these stars bright enough to be photographed with four prisms, all the lines of Group XII., Division *c* appear, their intensity being intermediate between that shown in ε Aurigæ of Group XII., Division *c*, and α Canis Minoris of Group XII., Division *a*.

In photographs taken with one prism, as previously stated in regard to stars of Division *ac* properly falling in Group XI., the most noticeable deviation from Division *a* is in the greater intensity of the line 4417.9, which coalesces with 4415.3.

The intensities of the lines of hydrogen and calcium are about the same as in stars of Division *a* or *b*, intermediate between Groups XI. and XII.

GROUP XII.

I. Typical star, α Canis Minoris.

II. Distinguishing features of the group.

1. The intensity of the K line is decidedly greater than that of the compound line H and Hε, the intensity of the latter being only seven or eight tenths that of the former.

2. The band at 4307 is faintly seen in plates taken with one prism. It is not nearly as strong as in the Sun and in stars of the solar type. The plates taken with four prisms show the appearance of this band to be due to the increased intensity of the lines 4299.2, 4300.8, 4302.6, 4305.8, 4308.0, 4309.5, and 4315.2, lying adjacent to one another so as to form a nearly, but not quite, continuous band. Line 4326.0 is also seen in the plates taken with one prism, but is not strong.

III. Further description.

1. The intensity of the lines of hydrogen is estimated at twenty-five hundredths of that shown in α Canis Majoris. All the lines of this system found in the early first type stars appear still to be present.

2. Three hundred and ten solar lines were found between Hη and Hβ. These, with their estimated intensities, are given in Table V. The number, it will be noticed, is nearly three times that found in Group VII., while the aggregate intensities of solar lines between Hε and Hβ in the two groups have the ratio of 100 to 430.

3. The bands of calcium are very wide, but do not equal those of the Sun and of stars of the later second type. Their intensity is estimated at about eight tenths that of the H and K bands in the Sun, and less than seven tenths those of α Boötis. The same estimate, however, gives their intensity as ten times that of the K line of α Geminorum of Group VIII. It will be apparent from the above description that spectra of this class are intermediate between the first and second types.

GROUP XII. — DIVISION *ab*.

The star β Cassiopeiæ has lines in a slight degree wide and hazy. This is the last group in the series in which the peculiarities of Division *ab* have been observed. As few of the stars of this group were photographed with four prisms, it may contain others with slightly widened lines.

GROUP XII. — DIVISION *c*.

I. Typical star, ε Aurigæ.

II. Differences as compared with Division *a*.

1. The intensity of the lines of hydrogen is probably less than in Division *a*. It appears to be two tenths that of the hydrogen lines of α Canis Majoris.

2. The metallic lines differ widely in relative intensity from those of Division *a*,

and strong lines are more abundant. In a few cases the wave lengths are different. The one hundred and fifty lines found between Hζ and Hβ are given with their estimated intensities in Table VII. It will there be seen that their resemblance to the lines of δ Canis Majoris is very marked. It is also further apparent that these lines are fewer in number, but in many cases stronger, than those found in Division *a*.

3. Lines 4299.2, 4302.6, 4314.3, and 4315.2 are seen in the plates taken with one prism; but the intermediate lines being invisible or extremely faint with this dispersion, no continuous G band appears.

4. The calcium bands appear to be narrower than in Division *a*. Their comparative width in the two divisions is uncertain, as it varies with different dispersions. In the plate taken with four prisms the width appears to be not more than five tenths as great in this division as in Division *a*. The spectrum on this plate is faint, yet this would probably not tend to decrease the width of the bands. From plates taken with fewer prisms the width should be seven or eight tenths, while in the plate taken with one prism it appears about the same as in Division *a*.

In all other groups the calcium lines are stronger in Division *c* than in Division *a*.

GROUP XII. — DIVISION *ac*.

The star *ν* Persei is intermediate between Divisions *a* and *c* in regard to metallic lines. For a more detailed description, see "Stars intermediate between Groups XII. and XIII., Division *ac*," which stars it resembles, but with which it has not been classed because the intensities of its hydrogen and calcium lines place it in Group XII.

STARS INTERMEDIATE BETWEEN GROUPS XII. AND XIII. — DIVISION *ac*.

I. Typical star, *α* Persei.

II. Differences as compared with Division *a*.

The metallic lines are intermediate in intensity between those of Divisions *a* and *c*. In the typical star all the lines of Group XIII., Division *c*, are present with two or three possible exceptions, but with intensity approaching that of the typical stars of Group XIII., Division *a*.

In photographs taken with one prism the differences between the spectra of the two divisions are not in general clearly marked, owing to the crowding of the lines. Spectra of Division *ac* can, however, be then distinguished by the greater intensity of line 4417.9, and by the fact that, in place of the wide band at 4307 containing all or nearly all of the lines found in the Sun between 4299.2 and 4315.2, a line composed of 4300.2 and 4302.6 is all that is usually shown. This line further appears hazy toward the blue, owing to the adjacent lines 4288.1, 4289.8, 4294.3, and 4297.1, some or all of which come out more distinctly than in stars belonging to Division *a*, and photographed with the same number of prisms. Again, the line 4326.0 is commonly invisible in the photographs of stars belonging to Division *ac*, taken with the same dispersion.

The lines of calcium have an intensity at least as great as in stars of Group XIII., belonging to Division *a*, and those of hydrogen have an intensity intermediate between the intensities shown in stars of the two groups belonging to Division *a*.

GROUP XIII.

I. Typical star, χ Orionis.

II. Distinguishing features of the group.

1. The spectrum agrees nearly with that of the Sun.

2. The lines of hydrogen, however, are decidedly stronger than in the Sun. Their intensity is estimated at two tenths of that in α Canis Majoris, and is intermediate between that given in the preceding group and that found in the Sun and other stars of Group XIV.

III. Further description.

The band 4307 and the calcium bands appear as in the Sun, and the number and intensity of the solar lines does not differ appreciably from that seen in the Sun and those stars of Group XIV. photographed with the same number of prisms. No stars of this group have been taken with more than two prisms, so that a more exact comparison cannot be made. This group may be called an arbitrary one, since the spectra classed in it present a gradation from the type of the preceding group to that of the Sun.

In stars approaching the preceding group, the band 4307 is faint, and the solar lines less strong, while the lines of hydrogen have nearly the same intensity as in Group XII.

GROUP XIII. — DIVISIONS *c* AND *ac*.

I. Typical stars, for Division *c*, δ Canis Majoris; for Division *ac*, α Ursæ Majoris.

II. Differences as compared with Division *a*.

1. The intensities of the solar lines in Division *c* are widely different from those of the lines of Division *a*, and the wave lengths in some cases are probably different.

The two hundred and fifteen lines found between K and Hβ are given, with their estimated intensities, in Table VII.

2. Spectra of Divisions *c* and *ac*, when photographed with one prism, may be recognized by the prevalence of strong lines, and by the defective G band. This band, so conspicuous in stars belonging to Division *a* and containing all lines of the Sun from 4299.2 to 4315.2, is here represented, as in Divisions *c* and *ac* of Group XII., chiefly by a line composed of 4300.2 and 4302.6. The line 4315.2, however, is commonly shown in good plates as a faint separate line. As in stars of Division *ac* of the preceding group, the defective G band appears hazy toward the blue on account of the greater intensity of some of the adjacent lines. Line 4326.0, if visible, is very faint.

3. The width of the calcium bands, as shown in the typical star of Division *c*, exceeds that found in any other class of stars in the series. The estimates vary with the dispersion of the spectra, but the average value taken from the different dispersions, both for the typical star and for the group, gave the intensities of the lines K and H as fourteen and fifteen tenths respectively of their intensities in the solar spectrum. This exceeds the intensity of these bands in α Boötis and α Tauri of Groups XV. and XVI., Division *a*, which have the maximum intensity of these bands in stars of that division.

The K band is probably not so wide in all the stars here included, but is in all cases at least equal to that of α Boötis.

4. In the intensity of their hydrogen lines the stars here described approach the following group. In the plates taken with one prism, Hγ and Hβ appear much stronger than the other hydrogen lines owing to the coalescence of Hγ with the strong line 4337.6, and of Hβ with 4855.7 and a band covering the solar lines at 4864.2 and 4866.5. In this group it was found impossible to separate Divisions *c* and *ac*. The group includes ρ Cassiopeiæ, δ Canis Majoris, γ Cygni, *d* Draconis, and α Ursæ Minoris. When taken in this order, these stars show a gradual transition of type from the extreme form of Division *c* to a form differing comparatively little from Division *a*. This fact was mentioned on page 5. In ρ Cassiopeiæ the peculiar strong lines of δ Canis Majoris are still stronger. They become less intense in each successive star, except that the third and fourth in order are probably alike. Again, in photographs of δ Canis Majoris taken with four prisms, a considerable number of the solar lines of stars belonging to Division *a* were not found, but in α Ursæ Minoris the number of solar lines absent was exceedingly few. This star also, under this dispersion, did not differ greatly from stars belonging to Division *a* in the general intensity of most of its lines.

Group XIV.

I. Typical stars, α Aurigæ, η Boötis, and the Sun.

II. Features determining the group.

1. The lines of hydrogen have not more than about fifteen hundredths their maximum intensity as seen in α Canis Majoris.

2. The G band is the most conspicuous feature of these spectra, except the bands of calcium. It contains the lines 4299.2, 4300.8, 4302.6, 4305.8, 4308.0, 4309.5, 4311.7, 4313.0, 4314.3, 4315.2, and others not separately visible, but appearing as a continuous haze, connecting the stronger lines into an almost unbroken band. It of course appears most unbroken in the plates taken with few prisms.

3. The combined intensity of the hydrogen line Hγ and line 4337.6, which, when photographed with few prisms, coalesces with Hγ, exceeds that of line 4326.0 even when the latter is combined with 4323.7. The intensity of the former compound line usually appears about twice that of the latter, but the ratio varies under different dispersions. When the lines are resolved, the line Hγ alone is seen to be stronger than line 4326.0.

III. Further description.

1. In the typical star α Aurigæ three hundred and twenty-eight solar lines were found between Hη and Hβ, and one hundred and forty seven appeared in the region between Hβ and D in plates stained with erythrosin. The total number found in the entire photographic spectrum was four hundred and eighty-eight. Since a large number of these are complex bands, the actual number of course is much greater, and in general it may be said that, with a few slight exceptions, all the clearly defined lines found in the photographs of the Sun taken with similar dispersion are present in this star, and have the same width and intensity.

The same is true for η Boötis in the regions covered by the photographs of that star. The few cases where variation was observed in the intensity of special lines are enumerated in the Remarks on Individual Stars, page 97.

The lines found in this group between Hη and Hβ, with their estimated intensities, are given in Table V. It will there appear that, with several exceptions, all the lines of Group XII. are included among those of this group. As the lines of α Aurigæ, however, are not as well defined as those of α Canis Minoris, many lines resolved in the latter star are united into bands in the former.

2. The calcium bands have nearly, but not quite, reached their maximum intensity. It is difficult to estimate their intensity in terms of any other lines, but the K band may perhaps be called equal to two or three times the line Hδ of α Canis Majoris,

when width is considered as one of the factors in intensity. Such estimates, however, vary so greatly with the dispersion employed as to be of little use.

3. A slight contrast is now visible in the intensity of the portions of the spectrum separated by the band 4307, that of shorter wave length being somewhat brighter in the negative, and therefore fainter in the star. This is not nearly so marked, however, as in the following group. The bands of increased brilliancy, 4315 to 4368, 4470 to 4525, and 4614 to 4648, are faintly seen in plates taken with one prism.

GROUP XIV. — DIVISION *ac*.

I. Typical star, η Aquilæ.

II. Differences as compared with Division *a*.

These spectra differ from Division *a* in nearly the same manner as α Ursæ Minoris differs from Group XIII., Division *a*. The difference, however, is less in degree, and the spectra are often barely distinguishable from those of Division *a*.

When photographed with one prism, and none of them have been photographed with more, they may be distinguished from spectra of Division *a* by the somewhat greater intensity of many of their solar lines, by the more or less imperfect G band, and by the apparently great intensity of the Hγ and Hβ lines, owing to coalescence with adjacent lines under the lower dispersion. In the G band, as in stars of this division in preceding groups, the only line of great intensity which commonly appears is 4300.2 to 4302.6, and this is hazy toward its edges owing to adjacent lines. Line 4326.0 is commonly faint or invisible, but sometimes clearly seen.

Hγ and Hβ have at least double the intensity of Hδ, owing, as in the preceding group, to the coalescence of Hγ with 4337.6, and of Hβ with 4855.7 and the band extending probably over the solar lines 4864.2 and 4866.5.

The remaining lines of hydrogen are the same as in Division *a*, or slightly approach the diminished intensity shown in the next group.

The width of the calcium bands varies. It however generally equals or exceeds that of stars belonging to Division *a* in Groups XV. and XVI., which is the maximum intensity found in stars of that division. This is the last group of the series in which stars representing Divisions *c* or *ac* have been found. If the three peculiar stars, ε Leonis, ξ Argus of this group, and ζ Capricorni, intermediate between Groups XIV. and XV., are in some degree allied to this division, the relation is not well established, and they lack some of the most constant features of stars belonging to Division *c*.

STARS INTERMEDIATE BETWEEN GROUPS XIV. AND XV.

I. Typical Star, κ Geminorum.

A number of stars intermediate between Groups XIV. and XV. were at first classed as a separate group.

II. Distinguishing features.

1. The intensity of the Hγ line in coalition with line 4337.6 is approximately equal to that of line 4326.0. This applies to the spectra as shown under the dispersion of a single prism, as none have been obtained under greater dispersion. Were the lines Hγ and 4337.6 resolved, the estimated intensity of the compound line would probably be increased..

2. The intensity of the hydrogen and calcium lines is intermediate between Groups XIV. and XV., that of the hydrogen lines being estimated at eleven hundredths of that of the lines of α Canis Majoris.

3. The degree of general absorption in the violet is less than in Group XV., but greater than in Group XIV.

4. Lines 4077.9 and 4215.7 commonly appear stronger than in the typical stars of either group. Line 4077.9 is not separated from 4076.8, and the increased intensity may therefore be due to the latter line. It is however probably due to change in 4077.9, since this line has in other stars shown a tendency to variation. The lines in general are very clear and distinct, although this may be due to the photographs.

5. In other respects these stars resemble those of Group XV.

GROUP XV.

0.42 -0.467

I. Typical stars, α Boötis and α Cassiopeiæ.

II. Distinguishing features of the group.

1. The intensity of the line 4326.0 exceeds the combined intensity of the line Hγ and 4337.6. This does not appear true, according to the estimated intensities of these lines as given in Table VII. The reason is that, when the components of a double line are separately estimated, the sum of the estimates will exceed the values estimated for the two as a single line. In photographs taken with one or with two prisms, the intensity of 4326.0 appears to be double that of Hγ and 4337.6; and this is true whether Hγ and 4337.6 are resolved or not. In photographs taken with four prisms this contrast is diminished, but the intensity of 4326.0 is still nearly double that of the line Hγ alone.

2. The line 4227.0 has not more than from one and a half to two times the intensity of the compound line 4383.7 to 4385.2. The former line is of course, under all dispersions, far less conspicuous than the band 4307.

3. The band 4307 still appears continuous, and resembles that of the Sun. There is a slight increase in intensity in some of the lines composing it.

III. Further description.

1. The lines of hydrogen have less than one tenth their maximum intensity as seen in *α* Canis Majoris.

2. In this group three hundred and thirty-seven solar lines were found between K and Hβ, and one hundred and sixty-one between Hβ and D. Thus, not including the many ultra-violet lines which appeared in plates of lower dispersion, nearly five hundred lines were found. The sum of the estimated intensities of lines between Hβ and H was 712, against 568 in Group XIV., Division *a*, of which the Sun is a typical star. Nearly all the lines of the preceding group are included, and their general intensity is increased. The relative intensity of the lines of this group, however, differs a little from that of the preceding; so that, while the triple line b, the lines 4063.7, 4143.9, and others, show a very marked increase, other lines have less intensity than in Group XIV.

3. The K line in this group has the maximum intensity found in Division *a*. It is estimated as about twelve tenths that of its intensity in the Sun. The line H has about eight tenths this intensity, which appears to be a little less than in the following group.

4. The contrast in the brightness of the portions of the spectrum separated by the band 4307 is greater than in the preceding group, but not nearly so marked as in the group following. The portion of greater wave length is rendered more intense by the three apparently bright bands, 4315 to 4368, 4470 to 4525, and 4614 to 4648, approximately, and by a diffused brightness extending from the G band to the line Hβ.

The portion of shorter wave length is rendered faint by general absorption, which is most visible between wave lengths 4144 and 4216, and between 4055 and 4078. This faintness in the violet is interrupted by a distinct bright region between wave lengths 4078 and 4096.

A sudden diminution in brightness occurring at wave length 3889 renders all rays of shorter wave length faint.

5. The narrow bright bands 5436.8 to 5445.2 and 5156.0 to 5167.6, which in stars of the third type form the borders of absorption bands, are clearly seen. These are faintly visible in the Sun. The stars of this group appear to fall into two

divisions, exhibiting a slight difference in the degree of general absorption in the violet region. Of these divisions *α* Boötis and *α* Cassiopeiæ are respectively typical. In the first, the general absorption is slight; in the second, it is more conspicuous, both in the regions of the violet above mentioned and beyond wave length 3889, where the photographic spectrum generally appears to be suddenly cut off. In the latter class of stars, also, the spectrum between lines 4215.7 and 4227.0 generally appears brighter. Frequently also the lines 4227.0 (except in *α* Cassiopeiæ), 4215.7, and the compound line 4076.8 to 4077.9 seem stronger, but this difference may be due to accidental photographic conditions. The degree of absorption indicated also varies in photographs of different density, so that while there seems to be sufficient ground for believing that the distinction is a real one, there is more or less liability to error in assigning individual stars to one or the other division.

Aside from these slight variations and from such as approach the preceding or the following group, the stars of this group have spectra which under the present dispersion are indistinguishable. This identity of the spectra is the more remarkable when we consider the number of stars included in this group, and the number of lines shown in their spectra. One hundred and eleven stars, out of the six hundred and eighty-one which were examined, fall in this group. Of these about twenty have been well photographed with two prisms, and show more than two hundred and thirty lines of exactly the same intensity as those shown in the similar plates of *α* Boötis. Several of these stars have been successfully photographed with four prisms, and give more than three hundred lines, none of which are distinguishable from those of the typical stars. The remaining stars are photographed with one prism, but as all the compound lines which crowd these spectra have the same intensity as those in the similar photographs of the typical stars, it is altogether probable that no disagreement would be found in photographs taken with more prisms.

STARS INTERMEDIATE BETWEEN GROUPS XV. AND XVI.

Typical stars, *β* Cancri and *α* Hydræ.

The general absorption in the violet is greater than in Group XV., and the contrast between the portions of the spectrum separated by the band 4307 is very great. The rays having wave lengths shorter than 3970 are faint and difficult to photograph.

The line 4227.0 is stronger than in stars of Group XV.

GROUP XVI.

I. Typical star, *α* Tauri.

II. Distinguishing features of the group.

1. The line 4227.0 has three or four times the intensity of 4383.7 to 4385.2. It is now the most conspicuous band in the spectrum excepting those of calcium. From its greatly increased width in this group, it would appear to be complex, and to include lines weak or absent in stars of the solar type.

2. The G band 4307 is no longer continuous, but, owing to the disappearance of 4311.7 and numerous fine lines which formed a connecting haze, it is broken into two distinct portions. Of the lines now composing it, 4299.2, 4300.8, 4302.6, 4305.8, 4308.0, 4309.5, 4313.0, and 4314.3 to 4315.2, all but the fifth and seventh have greater intensity than in *α* Boötis and the Sun.

3. The absorption bands seen in the green portion of spectra of the third type are absent, and the diffused brightness in the blue extends from the band 4307 to Hβ, and beyond. The bright bands 5156.0 to 5167.6, and 5436.8 to 5445.2, which border two of the absorption bands, however, are strongly marked.

III. Further description.

1. The lines of hydrogen are but little weaker than in the preceding group. They have seven or eight hundredths their maximum intensity as seen in *α* Canis Majoris.

2. The solar lines include all those of the preceding group, and nearly all of the following group. The intensity of these lines in the region of wave length shorter than 4860 is, in general, so nearly the same as in *α* Boötis that separate estimates have not been made. The principal differences observed, however, are enumerated on page 41. *α* Orionis of Group XVIII. has been used for comparison, since estimates of the intensities of its lines are given in Table V. Most of the lines between 4860 and 5900 also resemble in intensity those of *α* Boötis. The triple line b, however, the compound line 5204.8 to 5206.2, line 5208.7, and some other lines in this region, are stronger than in *α* Boötis. The general intensity of the lines of *α* Tauri in both regions is somewhat greater than in *α* Boötis.

3. Of the calcium lines, K is probably the same as in the preceding group, while the intensity of H may be somewhat greater.

4. The contrast in the brightness of the portions of the spectrum separated by the band 4307 is at a maximum in this group. In the portion of greater wave length, the bands 4315 to 4368, 4470 to 4525, and 4614 to 4648 are very strong, and numerous narrower bright bands appear. As these latter vary under different dispersions, and are perhaps merely due to the bright background, in absence of lines,

they have not been further studied. They are, for the most part, faintly visible in the Sun. The diffused brightness above mentioned renders this portion of the spectrum still more intense.

In the violet the absorption is more marked and more extensive than in the preceding group. It covers almost uniformly the portion of the spectrum having wave length shorter than the band 4307, except where interrupted by the bright region 4078 to 4096. The portion of the spectrum having wave length shorter than 3970 is faint and difficult to photograph.

There is no evidence of variation among the stars of this group, except such as constitutes an advance toward the group following. Five out of the twenty-three stars contained in the group have been photographed with either two or four prisms, so that they would show from two to three hundred lines, and all these show entire agreement. In four, the spectrum between Hβ and D has been photographed with the same result.

The star α Tauri, chosen as typical because the brightest star of the group, in reality approaches the group following, as a slight diminution in brightness occurs at 4762 and another at 4954, thus showing the incipient absorption bands of the third type.

Differences observed in the Solar Lines of α Tauri as compared with α Boötis.

Among the lines of α Tauri which have greater intensity than in α Boötis, and approach the intensity shown in α Orionis, the following have been noted: 4027.2, 4030.8, 4034.6, 4072.7, 4077.9, 4081.2, 4082.4, 4083.8, 4090.2, 4096.2, 4110.0, 4115.3, 4116.8, 4121.8, 4140.3, 4159.2, 4165.6, 4169.8, 4175.1, 4187.6, 4191.8, 4206.9, 4251.0, 4271.7, 4275.0, 4289.9, 4291.2 to 4292.2, 4305.8, 4309.5, 4326.0, 4337.6, 4405.0, and 4408.5.

The following appear to be stronger in α Tauri than in either α Boötis or α Orionis: 4044.0, 4047.4, 4112.0, 4152.2, and 4227.0.

Line 4044.7, not certainly present in the other stars, appears in α Tauri to be certainly included in the band whose centre is at 4045.9.

Line 4196.8 is weaker than in α Boötis, and perhaps weaker than in α Orionis. Line 4154.9 is probably weaker than in either star.

GROUP XVII.

I. Typical star, β Andromedæ.
II. Distinguishing features of the group.

1. The absorption bands having their edges of shorter wave length at 4762, 4954, and 5168, respectively, are clearly shown. They are not, however, as well marked as in the next group. The diffused brightness extending, in stars of the preceding group, from the band 4307 to Hβ is still seen overlapping the first mentioned absorption band; so that the latter is divided into halves of unequal intensity. These phenomena are best observed in plates taken with one prism.

2. The bright band 4556 to 4586, not entirely absent from the preceding group, is here clearly seen. It is as yet, however, weaker than any of the bands 4315 to 4368, 4470 to 4525, or 4614 to 4648.

III. Further description.

1. The lines of hydrogen and those of calcium have probably the same intensity as in the preceding group, the former being seven or eight hundredths as strong as the hydrogen lines of α Canis Majoris, the latter in the case of K and H respectively about twelve tenths and fourteen tenths as strong as the corresponding bands of the Sun.

2. The solar lines are those of α Orionis of the following group, and their intensity is intermediate between the intensities shown in that star and in α Tauri of the preceding group.

3. The contrast in brightness in the portions of the spectrum separated by the band whose centre is at 4307, the intensity of the apparent bright bands in the blue and elsewhere, the intensity of the compound line at 4227.0, and other features of these spectra, are nearly the same as in the preceding group.

No variation has been observed in stars of this group except such as consists in approximation toward the group following or the one preceding.

Group XVIII.

I. Typical stars, α Orionis and η Geminorum.

II. Distinguishing features of the group.

1. The four absorption bands having their edges of shorter wave length at 4762, 4954, 5168, and 5445, respectively, are all distinct, and the first three are strong. The diffused brightness extending from the G band now terminates at the edge of the first absorption band.

2. The bright band 4556 to 4586 is stronger than the band 4470 to 4525, but not so strong as the band 4614 to 4648.

III. Further description.

1. The hydrogen lines may vary to some degree in different stars of the group.

Their intensity is probably six or seven hundredths that of the hydrogen lines of α Canis Majoris. In α Orionis they are considerably stronger than in the remaining stars.

2. Three hundred and seven lines have been found between Hε and Hβ, and one hundred and fifty-six between Hβ and D. This makes in all four hundred and sixty-three lines, most of which are complex bands containing innumerable lines. With but few exceptions, all the lines of Group XV. are included, and probably also those of the intervening groups. The general intensity of the lines between Hε and Hβ is greater in this group than in Group XV. The sum of the estimated intensities between Hε and Hβ is 860 against 712 in that group. The intensity of the lines between Hβ and D does not appear to be greater, according to the estimates given in Table VI.; but these are probably too low, owing to faintness caused by the absorption bands. At all events, the triple line b, and other neighboring lines, are very strong.

3. The calcium bands are probably narrower than in the three preceding groups. They are only seen with difficulty in the photographs, owing to the faintness of the continuous spectrum.

4. The line 4227.0, as in Group XVI. and all the groups of the third type, is the most conspicuous band excepting those of calcium. It appears to be nearly as strong as in the two preceding groups, but varies in different stars.

5. The band 4307, as in Group XVI. and all the groups of the third type, appears divided into two parts, owing to the disappearance of central lines. The lines which remain, except 4308.0 and 4313.0, are stronger than in the preceding groups, yet are no longer conspicuous owing to the greater intensity of neighboring lines.

6. The contrast in the brightness of the portions of the spectrum separated by the band 4307 is marked. It is, however, not so strong as in the two preceding groups, owing to a diminution in the brightness of the bands 4315 to 4368 and 4470 to 4525. The diffused brightness is still marked between the band 4307 and the first absorption band at 4762. The absorption in the violet, except where interrupted by the brighter region 4078 to 4096 and a similar fainter one, is now uniform over the region between the band 4307 and Hε. Beyond this point the photographic spectrum is only seen with difficulty, owing to its faintness.

7. Of the four absorption bands mentioned at the beginning of the description of Group XVIII., the first three fade gradually in the direction of greater wave length, and appear each to extend nearly to the bright border of the succeeding band. The fourth is broken by a bright region extending from 5515 to 5587. They are all bordered by distinct bright bands, having wave lengths 4750 to

4762, 4949 to 4954, 5156 to 5168, and 5437 to 5445, respectively. Of these borders, the last two are very strong and well defined, the first two weaker and somewhat indefinite.

Stars of this group appear to vary only in the intensity of the hydrogen lines and of the line 4227.0.

α Orionis is not typical in either of these respects, having the lines of hydrogen about twice as strong as the average of the stars of the group, and the line 4227.0 hardly more than one third as strong. The degree of variation from the mean is much less in the case of the remaining stars.

GROUP XIX.

I. Typical star, ρ Persei.

II. Distinguishing features of the group.

1. The bright band having wave length 4556 to 4586 is stronger than the band 4614 to 4648. This last appears narrower than in the preceding group. These two are now the only conspicuous bright bands in the blue, the other two having almost entirely faded away.

2. The contrast in the light intensities of the portions of the spectrum separated by the band 4307 is slight, but still clearly evident. A diffused brightness still appears between the band 4307 and the edge of the absorption band 4762.

3. The four absorption bands having their edges of shorter wave length at 4762, 4954, 5168, and 5445, respectively, are very clearly marked, and stronger than in the preceding group. The bright borders mentioned as occurring in spectra of Group XVIII. are also stronger.

Traces of a new absorption band are thought to be visible, 4586 being probably the edge of shorter wave length.

III. Further description.

In this and the following group, lines are giving place to bands and flutings. The solar lines show a diminution in number and intensity, which is slight in this group, but unmistakable in the next. This is true in all parts of the spectrum, but more especially in the region covered by the absorption bands. That the lines really give place to the bands, and are not merely rendered invisible by them, is shown by the absence of lines in places where the absorption bands fade away. This is best seen in the case of the two bands having their edges of shorter wave length at 4762 and 4954, respectively.

Except in regard to this slight diminution, the solar lines are nearly the same as in the preceding group.

The lines of hydrogen and calcium and the line 4227.0 are probably of about the same intensity as in the preceding group. The now divided band at 4307 is still less conspicuous.

STARS INTERMEDIATE BETWEEN GROUPS XIX. AND XX.

Several stars, like α Herculis, appear to lie between Groups XIX. and XX. In these stars, the contrast between the brightness of the portions of the spectrum divided by the band at 4307 is slight or inappreciable. The flutings, also, are more marked, the lines are weaker, the band 4614 to 4648 is narrower, and the bands 4315 to 4368 and 4470 to 4525 are absent.

The stars g Herculis and BD. +44° 3877 show an even distribution of light from the edge of the absorption band 4762 to the line Hε. They should, therefore, really be classed in a separate group, and have not been included in Group XX. only because all stars of that group studied in this investigation have the hydrogen lines reversed. Besides this the dark lines in their spectra are not certainly known to be identical with those of the above stars.

The star BD. +44° 3877 shows distinctly the absorption band at 4586.

GROUP XX.

I. Typical star, ο Ceti.

II. Distinguishing features of the group.

1. The distribution of light is sensibly uniform from 4762 to Hε, and the photographic spectrum extends into the ultra-violet.

2. The entire portion of the spectrum having wave length greater than 4420 assumes a more or less fluted character. The primary absorption bands appear to break up into secondary ones, which also as a rule fade in the direction of greater wave length, and have the same tendency to recur at regular distances.

3. The lines of hydrogen are bright. Hγ, Hδ, Hζ, Hη, Hθ, Hι, and frequently Hκ, Hλ, Hμ, and Hν are seen. The bright Hβ may or may not be present; the line Hε is never seen bright, owing possibly to the superposed calcium band. The intensity is greatest in Hδ and declines in either direction, except that Hν is next to Hι in brightness. The reversal of the hydrogen lines is complete; no accompanying dark lines are shown. Compare the bright-lined stars of the Orion type, in which Hβ is brightest and the reversal is always incomplete.

III. Further description.

1. Absorption lines, if present in the portion of the spectrum having greater wave length, are for the most part indistinguishable among the bands and flutings. In the region of shorter wave length, lines are found agreeing in general with those of α Herculis, but less numerous and of less intensity.

2. The calcium lines and the line 4227.0 are about the same as in the preceding group; the divided band 4307 is even more insignificant than in that group.

3. The four absorption bands having their edges of shorter wave length at 4762, 4954, 5168, and 5445, respectively, are all very clear and strongly defined, and the bright borders described on page 43 under Group XVIII. are stronger than in the preceding groups. There is probably a new band having its edge of shorter wave length at 4586, and bordered by the bright band at 4556 to 4586. It is possible that the appearance of this new band may be merely due to a collection of flutings, although it appears quite distinctly in some stars.

4. Of the bright bands seen in the blue region of the spectra in preceding groups 4556 to 4586 and 4614 to 4648 alone remain. The first is narrow and inconspicuous.

Several new bands of slightly increased brilliancy are present, the one which is commonly strongest and most clearly defined having wave length 4408 to 4423 approximately. These are faintly visible in α Herculis.

5. A slight increase in brightness is sometimes seen at about the region 4100. This may vary with the changes in the magnitude of these stars.

PECULIAR STARS OF GROUP XX.

The stars χ Cygni and T Cephei, which are long-period variables having bright hydrogen lines, show a variation from the foregoing description of stars of this group. In these stars the maximum brightness is in the region of the bright bands in the blue 4556 to 4586 and 4614 to 4648. This is chiefly owing to the greater brilliancy of the bands themselves, but the absorption in the violet is probably greater than in o Ceti.

These stars should perhaps form another group. In distribution of light they might be thought to approach the preceding group, but their dark lines differ more from those of that group than do the lines of o Ceti, and they are therefore clearly not intermediate.

χ Cygni has the bright Hβ well marked.

GROUP XXI. — FOURTH TYPE STARS.

I. Typical stars, 19 Piscium, and BD. +38° 1539.

II. Distinguishing features of the group.

A very wide band of complete absorption is seen in the photographic spectrum, its edge of greater wave length being probably at or near 4862. This band is abrupt and bright bordered on the edge of greater wave length, and fades somewhat gradually on the other side.

III. Further description.

1. In photographs stained with erythrosin a similar absorption band is shown about midway between the first band and the region of the line D. In one photograph this band also is shown to be abrupt on the edge of greater wave length; the remaining plates are too faint to show whether this is true or not. The band however appears in all cases to fade gradually toward the violet.

2. A strong line is seen, probably in the neighborhood of D. Seven or eight other lines are visible at this end of the spectrum, and a few others elsewhere. These lines have not yet been identified with those of other classes of stars, owing to the total dissimilarity of the spectra.

GROUP XXII. — FIFTH TYPE STARS.

I. Typical star, H. P. 1311, in Canis Major.

II. Distinguishing features of the group.

Wide bright bands are shown on a faint continuous spectrum, most of these bands apparently agreeing with lines of hydrogen and prominent Orion lines. The strongest one, however, 4688, is a band which is probably present also in the spectra of gaseous nebulæ.

III. Further description.

Twelve bright bands were seen in H. P. 1311. In the three remaining stars of the fifth type which have been photographed with the same dispersion, the strongest bands only were visible, owing perhaps to the faintness of the stars.

The agreement of the principal bright bands of these stars with lines of hydrogen and Orion lines was first found at this Observatory in a study of the plates taken with the 8-inch telescope, and was brought to notice in an article entitled "A Fifth Type of Stellar Spectra," in the Astronomische Nachrichten, Vol. 127, p. 1. The photographs taken with the 11-inch telescope confirm the agreement, both by superposition on similar photographs of stars of the Orion type, and by means of micrometric measures.

Table III. gives, in the first column, the names of the hydrogen lines; in the second column, the wave length of these lines and of such of the Orion lines as have been identified with those seen in the spectrum of H. P. 1311; in the third, the wave length of the bands of H. P. 1311 as taken from a curve giving the relation between the micrometric measures of the bands of H. P. 1311, and the true wave lengths; in the fourth, the wave lengths of the same bright bands as obtained by Campbell and given in Frost's translation of Scheiner's Astronomical Spectroscopy, p. 274; in the fifth, the roughly estimated intensity of the bands; and in the last column, their approximate limiting wave lengths.

TABLE III.

BRIGHT BANDS OF H. P. 1811.

Des.	Standard.	Curve.	Campbell.	Intensity.	Limits.
Hζ	3889	3889	....	1	3878–3895
..	3926	3926	....	1	3923–3940
Hε	3970	3970	....	1	3965–3986
..	4026	4026	....	1	4015–4035
..	....	4059	....	4	4046–4072
Hδ	4102	4102	....	5	4088–4121
..	4200	4200	....	3	4190–4213
Hγ	4341	4340	4342	3	4325–4357
..	4543	4544	4544	2	4530–4563
..	....	4614	4614	2	4596–4630
..	4685	4688	4688	10	4671–4707
Hβ	4862	4862	4862	1	4849–4874

Composite Spectra.

Examples, ζ Aurigæ and δ Sagittæ.

Spectra of this class unite the characteristics of groups more or less widely separated in the series.

In most cases a well defined spectrum of the second or third type is combined with the strong hydrogen spectrum characteristic of the first type. Other combinations, however, occur in which the spectra are not so widely different.

In ζ Aurigæ a spectrum like that of *α* Boötis appears in combination with one of the Orion type; in δ Sagittæ, a spectrum of the third type, showing clearly the characteristic absorption bands in the region between 4762 and 5900, is combined with the strong hydrogen spectrum belonging to the first type.

In the single case of *o* Andromedæ, a spectrum of the Orion type was found united with one of the first type belonging to Division *c*.

The hypothesis already proposed at this Observatory, that stars having these anomalous spectra may be double, appears to explain all the principal facts observed.

Thus, when strong hydrogen lines occur in the spectrum of a star of the second or third type, the K line is invariably narrow or obscure. When the hydrogen lines are very strong, as though belonging to a star of the first type, like *α* Canis Majoris, the K line appears as a clouded band, having sometimes a fine central line. When the hydrogen lines have the moderate intensity seen in stars intermediate between the first and second types, the K line appears more or less narrow, with haze beyond the edges. Moreover, when the hydrogen lines are very strong, most of the solar lines characteristic of the second type disappear from the ultra-violet, while from Hδ to Hβ they are strongly marked. The predominance of the second type in the blue, and of the first type in the violet, is exactly what would be anticipated, especially if the star of the first type were the fainter, as is usually the case in known doubles.

This explanation is borne out by the well known tendency of binaries to exhibit contrasting types, and still further by the fact that one third of the anomalous stars thus independently grouped proved to be known doubles.

A means may thus be furnished of detecting close binaries when the types of the components differ.

It is interesting to observe that in all these stars but one, ο Andromedæ, the spectrum of the earlier type was the fainter.

It was generally easy to determine in these composite spectra, the group to which the primary spectrum belonged. That of the secondary spectrum was generally uncertain, owing to the fact that the hydrogen lines are narrowed by superposition on the bright continuous spectrum of the other star, while the K line is widened by superposition on the wider K band.

A list of stars of composite spectra is given in Table X. The groups of the primary spectra and the types of the secondary spectra are there indicated.

STARS OF ORION TYPE HAVING BRIGHT LINES.

Examples, γ Cassiopeiæ and 11 Monocerotis.

These spectra generally resemble those of the normal Orion groups, but have lines of hydrogen and prominent Orion lines partly or wholly bright. In the case of a few of the stars, as γ Cassiopeiæ and φ Persei, the resemblance to any particular group of Orion type stars is not close.

In the hydrogen spectrum of these stars, the bright lines are as a rule either centrally superposed upon, or adjacent to, the dark lines; that is, half the line is reversed. When they are centrally superposed, as in the case of γ Cassiopeiæ, there is commonly a double reversal; the bright bands lying upon wider dark ones, and being themselves centrally crossed by fine dark lines. In all such cases the brightness attains its maximum in the line Hβ, and decreases with each successive hydrogen line of shorter wave length.

The phenomena are very complex, and each case is discussed in the Remarks on Individual Stars. A list of the stars of this class is given in Table XI., the Orion group which they most closely resemble being indicated.

CHAPTER III.

THE ORION LINES.

TABLE IV. contains the results of the investigations made with regard to the Orion lines in the spectra of stars belonging to the first seven groups of the series described in Chapter I. Besides the Orion lines properly so called, the lines of hydrogen and calcium occurring in that portion of the spectrum to which the investigation related are included in Table IV., in the first column of which their designations are given. The second column contains the wave lengths of all the lines. The unit is the ten-millionth of a millimeter. Approximate wave lengths are indicated by the omission of the tenths of a unit. The third column contains six places for residuals, which correspond to six different methods of determining the wave lengths given in the previous column. A residual printed in Italics is to be regarded as negative, and corresponds to a measurement which gave a shorter wave length than that adopted in the second column. Both the positive and the negative residuals are given in terms of the last place in the adopted wave lengths; that is, in hundred-millionths of a millimeter. Instead of a residual, the letter A frequently occurs. When it stands in the first of the six places, it denotes that the adopted wave length was obtained from previously published measurements made by trustworthy authorities. Any numerical residuals which may occur in subsequent places then indicate the variations of the measurements made here from this accepted value, not from their own mean. The letter A, in any except the first place, signifies that the method of measurement corresponding to the place where the letter stands was the only method available for determining the wave length given in the second column. In such cases, therefore, the remaining places contain neither letters nor figures.

The residuals given in the second place result from measurements made with the scale divided to hundredths, and estimated to thousandths, of an inch. About thirty photographs of the spectra of seven stars, β Canis Majoris, β Orionis, γ Orionis, δ Orionis, ε Orionis, ζ Orionis, and κ Orionis, were measured in this manner, and the residuals given in the second place relate to the mean of all these measurements. In seven cases, however, those of the lines whose wave lengths are given as 3728.1, 3779.5, 3784.6, 3790.9, 3805.1, 3876.4, and 3881.7, the results were obtained by interpolation between the wave lengths previously found for adjacent lines.

The residuals given in the third place result from the study of photographs of the spectra of β Persei and β Orionis. In these photographs, the relative positions of lines were repeatedly estimated with respect to other lines of known wave length, on each side of the lines the wave lengths of which were to be determined. This method enables some faint lines to be measured, which would escape observation under the microscope. The two stars above mentioned were chosen to serve as a basis for the estimates, because their spectra contain many known lines of the solar spectrum, although they do not appear in Table IV. Of the two stars, the solar lines are more prominent in the spectrum of β Persei, and the Orion lines in that of β Orionis, as appears above in the general description of Group VI., page 21.

The residuals given in the fourth and fifth places respectively express the results of measurements made with the dividing engine mentioned on page 2, and reduced, as there described, on photographs of the spectra of β Persei and β Orionis. The plates used for these measurements were, for β Persei, C 1050, taken February 6, 1888, with an exposure of 86^m, and twice measured; C 1060 and C 1061, both taken on February 9, 1888, with exposures of 87^m and 108^m respectively; for β Orionis, C 399, taken March 8, 1887, with an exposure of 72^m, and measured three times; C 415, taken March 25, 1887, with an exposure of 79^m, and measured three times; and C 1492, taken October 29, 1888, with an exposure of 119^m, and twice measured.

The residuals given in the sixth place result from three additional measurements of plate C 1492, representing the spectrum of β Orionis, as just stated. This plate had been exposed for 119 minutes, and the brighter portions of the spectrum were over exposed, so that only the more marked lines were visible, while in the ultraviolet portion even the fainter lines were well shown. Residuals in this sixth place accordingly appear only for lines of wave length shorter than 4036.0.

The fourth column of Table IV. gives in its five successive numbers the result of estimates of the relative intensity of the lines seen in typical spectra of Division *a* of Groups II., III., IV., V., and VI., respectively. As Group I. contains only stars of Division *b*, it is not represented in this column. Almost all the estimates were made upon an arbitrary scale, the number 1 representing the faintest lines, the interrogation point a doubtful trace of a line, and the figure 0 the absence of the line in the photographs examined. The omission of any symbol signifies that the image was too faint to enable any conclusion to be reached with regard to the presence or absence of a line. In the case of the very strong lines, as comparison of these with the faint lines is liable to great uncertainty, the numbers have been so chosen as to preserve the true relation of the strong lines to one another in the successive groups. As shown below, the dispersion employed in taking the photographs was not always the same, and allowance was made in the estimates for this circumstance.

In all the groups the estimates for lines having wave lengths less than 3889 were derived from spectra photographed by means of one or two prisms only, since in them the lines were most distinct in the ultra-violet region. But in that region, beyond the line Hθ, the variation in focus makes the estimates for the hydrogen lines rather doubtful. For greater wave lengths, plates photographed with four prisms were preferred, and in the case of Group II., ϵ and κ Orionis were the stars from the spectra of which the estimates were derived, the mean of the two estimates being employed when they differed. In the other groups, β Canis Majoris was the star taken to represent Group III., γ Orionis was that representing Group IV., η Tauri and ζ Draconis those representing Group V., and β Persei that representing Group VI. Except the two stars representing Group V., these were all photographed with four prisms.

The fifth column of Table IV. indicates by means of dots the presence of the successive lines in Division *b*, Groups I. to VI. inclusive. No estimates of the relative intensity of these lines were made. The absence of any one of the six dots in the column indicates the absence of a given line in the corresponding group. For Group I., the stars chiefly studied were ι and λ Orionis, S Monocerotis, and ξ Persei; for Group II., δ and ζ Orionis; for Group III., α Virginis; for Group IV., η Ursæ Majoris and λ Tauri; for Group V., τ Orionis; and for Group VI., α Leonis. The photographs used for Groups I. and V. had been taken with one or two prisms, the remainder with four.

The sixth column of Table IV. relates to spectra belonging to Division *c*, in five successive groups: III., V., VI., the group intermediate between VI. and VII., and finally Group VII. The presence or absence of lines is shown by dots, as in the fifth column. No stars belonging to Division *c* were found in other Orion groups than those just named. For Group III. the star employed was χ^2 Orionis; for Group V., chiefly η Canis Majoris; for Group VI., β Orionis; for Group VI.–VII., chiefly H. P. 551 and 4 Lacertæ; and for Group VII., η Leonis. Of these χ^2 Orionis was photographed with one prism, and the remainder with two, except η Canis Majoris and β Orionis, which were photographed with four prisms.

TABLE IV.

WAVE LENGTH, INTENSITY, AND DISTRIBUTION OF ORION LINES.

Des.	λ	Residuals.	Div. *a*.	Div. *b*.	Div. *c*.
	3584.	. . . . . .	6 6		
	3634.	. . . . . .	6 6 0		
Hσ	3683.5	A			.
Hρ	3686.7	A			.
Hπ	3691.5	A			.
Ho	3697.4	A	0 0 0 15 15		. . .
Hξ	3704.0	A	13 20 25 20 20	. . . . . .	. . . . .
Hν	3711.8	A	10 10 20 30 30	. . . . . .	. . . . .
Hμ	3721.9	A	12 15 30 50 55	. . . . . .	. . . . .
	3728.1	. A	3 0 0 0 0		
Hλ	3734.2	A	13 25 35 60 65	. . . . . .	. . . . .
Hκ	3750.2	A	15 25 35 65 75	. . . . . .	. . . . .
	3760.1	. . . . . A	1 2 0 0 0	. .	.
Hι	3770.8	A	15 25 35 65 75	. . . . . .	. . . . .
	3779.5	. A	1 1 0 0 0		
	3784.6	. A	1 1 1 0 0	.	. .
	3790.9	. A	1 1 0 0 0	.	
Hθ	3798.1	A 5	15 25 35 65 75	. . . . . .	. . . . .
	3805.1	. A	1 2 3 0 0	.	. . .
	3812.4	. . . . . A	1 0 0 0 0		.
	3819.2	. . . . . A	10 13 13 6 3	. . . . . .	. . . . .
Hη	3835.5	A *5*	15 25 35 65 75	. . . . . .	. . . . .
	3850.	. . . . . .	1 1	.	
	3854.2	. . 5 . . *6*	0 0 0 1 1		.
	3856.2	. . 3 . . *3*	0 1 1 3 3	. . . .	. . . . .
	3863.2	. . 7 . . *8*	0 0 0 2 2		. . . .
	3864.	. . . . . .	0 1 ? 0 0		
	3867.6	. . . . . A	1 1 2 1 1	. . . .	. . .
	3872.4	. . 3 . . *2*	0 1 2 1 1	. .	. .
	3876.4	. A	0 1 1 0 0		
	3881.7	. A	1 1 0 0 0		
Hζ	3889.1	A 0 . . . 1	15 25 25 65 75	. . . . . .	. . . . .
	3912.2	. A	1 1 1 0 0	.	
	3920.6	. *5* . . . 5	1 1 2 0 0		.
	3925.9	. A	0 1 2 1 0	. . . .	. . .
	3927.1	. A	1 1 4 2 0	. . . .	. . .
K	3933.8	A 0 . . . 0	2 1 3 4 6	. . . . . .	. . . . .
	3947.8	. A	1 1 1 0 0	.	
	3954.8	. A	1 1 1 0 0	.	
	3962.	. . . . . .	1 0 0 0 0		
	3964.6	. *3* . . . 4	2 3 4 0 0	.	. . .
H	3968.6	. . . . . .	0 0 0 0 80		? . . . .
Hε	3970.2	A *3* . . . 0	15 25 35 65	. . . . . .	. . . . .
	3975.2	A	1 1 ? 0 0		
	3982.8	A . . . `.	1 1 ? 0 0	.	.
	3994.9	*2* . . . 2	1 2 2 0 0	.	. . .
	4009.5	. 0 . . . 0	2 6 7 3 1	. . . . .	. . . .
	4026.4	. *4* 5 1 *1 1*	10 12 12 6 5	. . . . . .	. . . . .
	4036.0	. A	0 0 1 0 0		.
	4042.2	. A	1 1 ? 0 0		
	4069.4	. A	1 2 1 0 0	. . .	. .
	4072.0	. A	1 1 1 0 0	.	.
	4075.9	. A	1 2 1 0 0	. . .	. . .
	4084.9	. A	1 1 1 0 0	.	
	4089.2	. A	10 2 1 0 0	. . .	.
	4093.7	. A	0 1 0 0 0		
	4096.9	. A	3 1 0 0 0	. . .	
Hδ	4101.8	A 0	15 25 35 65 75	. . . . . .	. . . . .
	4111.2	. A	0 1 1 0 0	.	
	4116.2	. A	6 1 0 0 0	. .	.
	4120.5	. A	3 7 4 2 2	. . . . .	. . . . .
	4128.5	. 3 1 1 *4* .	0 ? 1 3 3	. . .	. . . .
	4131.4	. 1 *2* 6 *4* .	0 0 1 3	. . .	. . . .
	4134.0	. A	1 1 ? 0 0	.	.
	4144.0	. 0 *1* . . .	3 7 8 4 2	. . . . . .	. . . . .
	4152.	. . . . . .	0 0 1 0 0		
	4154.7	. A	1 1 1 0 0	. . . .	. . .
	4169.2	. A	0 1 2 0 0	. .	. .
	4186.2	. A	1 0 0 0 0	. .	
	4200.3	. A	1 0 0 0 0	. .	
	4224.8	. A	0 0 1 0 0		
	4237.4	. A	0 1 1 0 0		? .
	4242.6	. A	? 1 1 0 0		? .
	4254.1	. A	2 2 1 0 0	. .	?
	4267.4	. *1* 2 *1* . .	1 2 3 2 1	. . .	? . . .
	4276.7	. A	1 1 1 0 0	. .	
	4285.1	. A	1 1 1 0 0	.	
	4304.4	. A	1 1 1 0 0	.	.
	4318.0	. A	1 1 1 0 0	.	.
	4320.7	. A	1 1 1 0 0	.	. .
	4327.3	. A	1 1 0 0 0		
	4334.5	. A	0 1 0 0 0		
Hγ	4340.7	A 3	15 25 35 65 75	. . . . . .	. . . . .
	4346.	. . . . . .	1 0 0 0 0		
	4350.1	. A	2 1 1 0 0	. .	.
	4361.0	. A	0 1 0 0 0		

Des.	λ	Residuals.	Div. *a*.	Div. *b*.	Div. *c*.
	4367.3	. A	1 1 1 0 0	. . .	
	4373.2	. A	0 1 1 0 0		
	4380.1	. A	1 0 0 0 0	. .	
	4387.8	. 0 *8* 0 9 .	3 7 8 4 1	. . . . . .	. . . .
	4395.7	. A	0 1 ? 0 0	.	
	4415.1	. A	1 1 1 0 0	.	
	4417.5	. A	1 1 ? 0 0	.	. .
	4437.9	. A	0 1 2 0 0	.	. . .
	4447.7	. A	0 0 1 0 0		. .
	4471.8	A 0 1 6 5 .	10 11 12 5 4	. . . . . .	. . . . .
	4481.4	A 4	1 1 2 3 4	. . . . .	. . . .
	4490.6	. A	1 0 ? 0 0		
	4514.5	. A	0 ? 1 0 0	.	
	4531.4	. A	0 1 1 0 0	.	.
	4542.7	. A	1 0 0 0 0	. .	
	4553.4	. 0 0 . . .	2 3 2 1 0	. .	. .
	4568.6	. A	2 2 2 0 0	. .	. . .
	4576.5	. A	1 1 1 0 0	.	. . .
	4591.6	. A	1 1 ? 0 0	.	
	4598.2	. A	1 1 0 0 0	.	
	4603.7	. A	0 0 1 0 0		
	4611.2	. A	? 1 0 0 0		
	4619.8	. A	0 1 1 0 0	.	
	4630.6	. A	1 1 1 0 0	.	.
	4641.1	. A	2 2 1 0 0	.	.
	4649.2	. A	12 7 2 0 0	. . .	. .
	4661.7	. A	2 2 1 0 0	.	
	4675.3	. A	1 1 1 0 0	. .	.
	4685.4	. A	2 0 0 0 0	. . .	
	4697.9	. A	1 1 0 0 0	.	
	4705.0	. A	1 1 0 0 0		
	4712.8	. A	2 2 2 1 1	. . . . .	. . .
Hβ	4861.5	A *1*	15 25 35 65 75	. . . . . .	. . . . .
	4925.7	. A	4 6 6 3 1	. . . . . .	. . . .
	5023.	. . . . . .	1 1 1 1	. .	. . . .

REMARKS.

3805.1. In Group II. this line is probably combined with one having greater wave length.

3856.2. In stars of Group II. an indistinct line having greater wave length appears. This may be due to the presence of a second line.

3920.6 and 3925.9. In stars of Division *a*, both these lines are present. Owing to their faintness in stars of Division *b* it was not possible to determine which of the two was present, or whether both were included. In Group I. the line appearing in this region may have a wave length greater than either of the lines named above.

3968.6. Apparently combined with Hϵ in Group VI., Division *a*. In Group III., Division *c*, its presence was doubtful, owing to insufficient dispersion; but as Hϵ seemed to have relatively great intensity, and as K was also intense, it is probable that the calcium line H is present in the spectrum.

4009.5. This line is present in some stars of Group VI., Division *a*; for example, in β Tauri. It is not found in β Persei.

4318.0 and 4320.7. Owing to the low dispersion it is uncertain which of these lines is present in χ^2 Orionis. Probably both are included.

4415.1 and 4417.5. Both these lines appear in stars of Division *a*. It is uncertain which of these lines is present in Division *c*, or whether both are included.

The general comments to be made on the results of Table IV. may be divided into those relating respectively to the three divisions.

Division a. In Groups II. and III., as in Group I., Division *b*, the line Hξ, which in these groups terminates the system of hydrogen lines, has greater intensity than the lines Hμ and Hν, the last named being the faintest. In Group IV., Hξ is stronger than Hν, but fainter than Hμ, and in all following groups of Orion and first type stars the intensity regularly diminishes with decreasing wave length. The line Ho first appears in Group V. The number and intensity of the Orion lines diminish as the series approaches the first type, as appears by inspection of Table IV. Beyond

Group VI. the only Orion lines which commonly persist in stars of Division *a* are 4128.5 and 4131.4. These become fainter and disappear in the first type groups.

The lines 4481.4 and 4144.0 fall within solar bands. The former increases in intensity toward the first type, and reaches its maximum in Group VIII., becoming fainter in the later groups. There is no proof that it may not be one of the components of the solar band. In the case of the line 4144.0, however, there is reason to doubt its real identity with the solar line, owing to its great intensity in Group IV. and its steady diminution to the first type. It will appear from Table V. that the double solar line having its centre at 4143.9, from which the Orion line is indistinguishable, becomes faintest in Group VII. and increases rapidly as far as Group XV. Both components, but especially 4144.0, are strong in the Sun.

While, therefore, the line 4144.0 appearing in spectra of the Orion type may agree with one of these components, it appears to be more safely classed as an Orion line.

Division b. In this division there is a maximum number of Orion lines in Group III. This may be partly due to the fact that in α Virginis, the star of Group III. of which the best photographs have been obtained, the widening of the lines is not great. Hence few faint lines are lost.

It is interesting to note that Group VI., Division *b*, contains the smallest number of lines found in any group of the series.

No solar lines are present in any of these groups of Division *b*. This statement does not apply to the two lines 4144.0 and 4481.4 present in Orion stars generally, and having a real or apparent agreement with solar lines.

In α Virginis of Group III. six lines were found between 4860 and 5900 on a plate stained with erythrosin. Their wave lengths have not been determined, and it is not known whether they are present in any other stars of the Orion type.

Division c. The intensities in the earlier groups do not differ greatly from those in stars of Division *a*, the few marked cases being mentioned in Chapter II., "Detailed Description of the Classification." The lines, however, are sharper, and in general more conspicuous. The most important difference is, that the lines retain their intensity longer than those of Division *a*, many of them persisting and being fairly conspicuous in Group VII.

The maximum number of lines, according to Table IV., should be in Group VI. This, however, probably does not represent the true proportion, since the plates of β Orionis were of exceptionally fine quality, while those of χ^2 Orionis, being somewhat faint and taken with a single prism, show a much smaller number of lines.

A number of metallic lines are present in the stars of Division *c* from Group VI. onward. These are given in Table VII.

CHAPTER IV.

SOLAR LINES BETWEEN 3686 AND 4862.

TABLE V. shows the distribution and roughly estimated intensity of the lines in stars of Division *a* from Group VI. to Group XVIII. These lines include almost all the lines seen in photographs of the solar spectrum taken with the same number of prisms, besides a few others. All the lines are found on Rowland's map of the solar spectrum, some of the faint lines there shown coming out more strongly in stars of Group XV. and the groups following. The lines of hydrogen and calcium are included in the table.

The first column contains the designation of such lines as are known by letters. In the second column are the wave lengths taken from the second edition of Rowland's map of the solar spectrum; the wave lengths of the lines of hydrogen and calcium, however, are taken from a memorandum kindly furnished by Professor Rowland in advance of publication. The third column shows the intensities of the lines as found in β Persei, the typical star of Group VI. The fourth column shows the intensities of the lines as found in α Canis Majoris, the typical star of Group VII. The fifth, sixth, seventh, eighth, and ninth columns, respectively, show the intensities for α Geminorum of Group VIII., α Canis Minoris of Group XII., α Aurigæ of Group XIV., α Boötis of Group XV., and α Orionis of Group XVIII. It is to be regretted that none of the Groups IX., X., or XI. could be represented, since they contain no stars of Division *a* bright enough to be well photographed with four prisms. α Tauri of Group XVI. was omitted, owing to the close resemblance in intensity of nearly all its lines to those of α Boötis.

The intensities given in this table are estimated on an arbitrary scale. The number 1 represents the faintest lines; while in the use of the higher numbers the attempt has been made to express as nearly as possible the changing intensity of each line in the successive typical stars, as well as its relation to the other lines of the same star. An interrogation point indicates that an uncertain trace of a line is present. A zero indicates that a line is absent, or too faint to be visible on a good plate. A dot indicates that the presence or absence of a line is undetermined. This has been used in the region of the ultra-violet, where the faintness of the light renders it difficult to obtain a distinct image under the highest dispersion.

In cases where the lines whose wave lengths are given in the table appeared as a single band, the combined intensity is given, and is placed between the two lines in the table. The combined intensity of a band containing three of these lines is placed opposite the middle line, the absence of the zero opposite the preceding and following lines indicating that the given intensity is that of the three combined. Estimates of combined intensity are generally a little less than the sum of the intensities of the same lines when estimated separately.

An estimate of the intensity of the lines in Rowland's map of the solar spectrum is given in the tenth column. The scale is such that the densest lines were estimated as 5, and the faintest lines as 1. The letter d denotes that the estimated intensity is that of two lines, and g that of a group. Since in these photographs the dispersion diminishes as the wave length increases, it follows that, when the wave length is great, two lines may appear as a single line, although widely separated in the normal spectrum.

The remaining columns of Table V. contain residuals derived as follows. A number of plates, which are named at the tops of the respective columns, were measured with a dividing engine, having two screws at right angles to each other, the pitch of each screw being $\frac{1}{24}$ of an inch. These screws moved a metal plate, on which the photograph was placed, beneath a fixed microscope. The arbitrary readings obtained in this manner for the position of any given line were first reduced by subtracting such a quantity from each that the readings for all the plates agreed at the line Hγ. They were then reduced approximately to wave lengths by means of an empirical table. This reduction enabled each line to be identified with the corresponding line in the solar spectrum as given by Rowland. Residuals were then found by subtracting the values given by Rowland from the corresponding measured values. These residuals were next plotted as points on a chart in which their values were the ordinates, while the abscissas represented wave lengths. A smooth curve was then drawn through these points, and systematic corrections were found from the curve and applied to the measured values in order to reduce them to Rowland's scale. The individual residuals remaining after these corrections, and found, as before, by subtracting the value given by Rowland from the measured value, are those given in Table V., as above stated, negative values being indicated by Italics. The systematic errors having been removed, as just explained, these residuals show the actual deviations, if any, of the lines, combined with the accidental errors of measurement.

All of these lines were also identified independently by direct comparison with a photograph of the solar spectrum taken with the same dispersion, and thus compared with Rowland's map. This identification was checked in detail with the results of the measurements, and all cases of discordance carefully investigated.

TABLE V.

SOLAR LINES.

Desig.	Wave Length.	VI.	VII.	VIII.	XII.	XIV.	XV.	XVIII.	S. S.	470	484	1486	1507	387	493	1066	453	1717	505	634	393	429	401	475	1493	1504
Hρ	3686.7	15	15	.	6	.	.	.	.	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Hπ	3691.5	20	20	.	6	.	.	.	.	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ho	3697.4	25	25	.	6	.	.	.	.	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Hξ	3704.0	30	30	.	12	.	.	.	.	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Hν	3711.8	35	35	.	12	.	.	.	.	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Hμ	3721.9	45	45	.	16	.		.	.	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	3727.5	.	2	.	.	.	.	.	4	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Hλ	3734.2	50	50	.	16	.	.	.	.	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	3737.1	.	3	.	.	.	.	.	5	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	3741.7	.	2	.	.	.	.	.	3	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	3743.5	.	2	.	.	.	.	.	4	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	3745.8	.	3	.	.	.	.	.	5	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Hκ	3750.2	55	55	.	16	.	.	.	.	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	3758.2	.	3	.	.	.	.	.	5	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	3761.5	.	2	.	.	.	.	.	3	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	3764.0	.	2	.	.	.	.	.	4	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Hι	3770.8	65	65	60	16	.	.	.	.	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	3782.0	.	2	.	.	.	.	.	2 g	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	3786.3	.	1	.	.	3	.	.	4 g	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	3788.0	.	1	.	.	?	.	.	3	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	3790.0	.	1	.	.	2	.	.	3 g	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	3795.0	.	1	.	.	2	.	.	4	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Hθ	3798.1	65	65	60	16	?	.	.	.	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	3798.7	.	0	.	.	3	.	.	4	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	3799.8	.	0	.	.		.	.	4	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	3802.0	.	?	.	.	2	.	.	3 g	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	3807.3	.	1	.	.	3	.	.	3 g	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	3813.1	.	2	.	1	3	.	.	3	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	3814.9	.	2	.	.	0	.	.	3 d	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	3816.0	.	2	.	1	3	.	.	5	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	3820.5	3	2	.	3	5	.	.	5	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	3822.0	.	1	.	.	0	.	.	3	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	3824.6	.	2	.	.	2	.	.	4	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	3826.0	.	2	.	.		.	.	5	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	3828.0	.	2	.	.	2	.	.	4	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	3829.6	.	2	.	.		.	.	4	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	3832.5	.	2	.		2	.	.	4	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	3834.4	.	0	.		2	.	.	4	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Hη	3835.5	65	65	60	25	4	.	.	3 g	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	3838.4	.	3	.		.	.	.	4	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	3840.8	.	3	.		4	.	.	4 g	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	3843.6	.	0	.	1	1	.	.	3 g	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	3845.4	.	0	.	1	1	.	.	3 g	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	*0.4*	. .	. .	. .	. .
	3846.9	.	0	.	1	1	.	.	3	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	3850.0	?	3	3	3	6	.	.	4	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	*1.1*	. .	. .	. .	. .

Desig.	Wave Length.	VI.	VII.	VIII.	XII.	XIV.	XV.	XVIII.	S. S.	470	484	1486	1507	387	493	1086	453	1717	505	634	393	429	401	475	1493	1504
	3852.7	.	0	0	0	2	.	.	3 d	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	0.2	. .	. .	. .	. .
	3854.6	1	2	1	0	2	.	.	3 g	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	0.3	. .	. .	. .	. .
	3856.5	3	4	4	4	5	.	.	4	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	1.0	. .	. .	. .	. .
	3858.4	0	0	0	0	3	.	.	3	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	0.4	. .	. .	. .	. .
	3860.0	0	1	1	3	5	.	.	5	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	0.2	. .	. .	. .	. .
	3861.6	0	0	0	0	4	.	.	4 g	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	1.0	. .	. .	. .	. .
	3863.9	1	2	2	1	1	.	.	2	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	0.7	. .	. .	. .	. .
	3865.7	0	1	1	1	2	.	.	4	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	3867.2	0	0	0	?	1	.	.	2 g	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	3868.4	0	0	0	0		.	.	3 g	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	0.1	. .	. .	. .	. .
	3872.7	0	2	3	3	10	.	.	4	*0.5*	0.0	. .	. .	. .	. .	. .	. .	. .	. .	. .	*1.1*	0.9	. .	. .	. .	. .
	3876.0	0	0	0	2	1	.	.	2 g	. .	. .	. .	. .	. .	. .	. .	. .	. .	*1.2*	. .	*0.9*	*0.5*	. .	. .	. .	. .
	3878.5	0	3	4	10	8	.	.	5	*0.1*	1.0	. .	. .	. .	. .	. .	. .	. .	*0.7*	. .	0.9	1.3	. .	. .	. .	. .
	3880.3	0	0	0	2	1	.	.	2 d	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	0.6	. .	. .	. .	. .
	3883.2	0	0	0	2	8	.	.	4	. .	. .	. .	. .	. .	. .	. .	. .	. .	0.0	. .	*1.1*	*0.6*	. .	. .	. .	. .
	3886.4	0	0	0	0	8	.	.	4	. .	. .	. .	. .	. .	. .	. .	. .	. .	*1.0*	. .	*1.1*	*0.6*	. .	. .	. .	. .
	3887.1	0	0	0	1		.	.	3	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Hζ	3889.1	65	65	60	16	8	.	.	. .	0.3	0.2	. .	*0.3*	. .	. .	. .	. .	. .	. .	. .	*0.3*	*0.2*	. .	. .	. .	. .
	3890.5	0	0	0	0	1	.	.	1 g	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	0.4	0.8	. .	. .	. .	. .
	3892.0	0	0	0	0	1	.	.	2	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	1.0	. .	. .	. .	. .	. .
	3893.3	0	0	0	1	2	.	.	3	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	0.8	0.4	. .	. .	. .	. .
	3895.5	0	0	0	3	6	.	.	4 g	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	*0.3*	0.2	. .	. .	. .	. .
	3898.1	0	0	0	2	2	.	.	3	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	*0.7*	*0.3*	. .	. .	. .	. .
	3899.9	0	0	0	1	2	.	.	3	. .	. .	. .	. .	. .	. .	. .	. .	. .	*0.7*	. .	*0.2*	*0.5*	. .	. .	. .	. .
	3900.7	0	3	2	1	2	.	.	2	*0.2*	*0.6*	. .	*0.2*	. .	. .	. .	. .	. .	. .	. .	*0.1*	*0.3*	. .	. .	. .	. .
	3903.1	0	2	3	3	5	.	.	3	. .	0.4	. .	0.0	0.5	. .	. .	. .	. .	*0.2*	. .	0.0	0.1	. .	. .	. .	. .
	3905.6	2	3	3	3	4	.	.	4	. .	. .	. .	*0.1*	0.3	*0.3*	. .	. .	. .	. .	. .	0.2	0.1	. .	. .	. .	. .
	3906.6	0	0	?	?	2	.	.	2	*0.3*	*0 3*	. .	. .	0.2	0.0	. .	. .	. .	0.1	. .	. .	. .	. .	. .	. .	. .
	3907.8	0	0	0	0	1	.	.	2 d	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	*1.0*	. .	. .	. .	. .	. .
	3908.9	0	0	0	0	1	.	.	1	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	*1.1*	*0.2*	. .	. .	. .	. .
	3910.0	0	0	0	?	1	.	.	3	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	0.4	*0.1*	. .	. .	. .	. .
	3910.8	0	0	0	0	1	.	.	2 g	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	0.8	0.0	. .	. .	. .	. .
	3912.0	0	0	0	0	1	.	.	1 d	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	0.0	. .	. .	. .	. .
	3913.6	1	2	2	2	1	.	.	3 d	0.0	0.1	0.2	0.0	. .	. .	. .	. .	. .	0.3	. .	. .	. .	. .	. .	. .	. .
	3914.5	0	1	2	2	2	.	.	3 d	. .	. .	. .	. .	*0.2*	. .	. .	. .	. .	. .	. .	*0.5*	*0.4*	. .	. .	. .	. .
	3916.4	0	1	2	3	3	.	.	2 d	. .	. .	. .	. .	. .	. .	. .	. .	. .	0.0	. .	. .	. .	. .	. .	. .	. .
	3917.2	0	0	?			.	.	2	*0.1*	*0.2*	. .	. .	*0.1*	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	3918.6	0	?	1	3	3	.	.	3 d	0.5	0.4	. .	. .	0.5	*0.4*	. .	. .	. .	*0.1*	. .	*0.2*	0.3	. .	. .	. .	. .
	3920.4	0	1	2	3	5	.	.	3	0.4	0.7	. .	. .	1.3	*0.1*	. .	. .	. .	0.5	. .	. .	. .	. .	. .	. .	. .
	3921.0	0	0	0	0		.	.	3 g	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	0.0	*0.2*	. .	. .	. .	. .
	3923.0	0	1	2	3	3	.	.	4	0.4	0.4	. .	. .	0.5	. .	. .	. .	. .	0.1	. .	0.3	0.4	. .	. .	. .	. .
	3926.0	0	?	1	3	3	.	.	3 d	0.1	0.5	. .	. .	0.6	. .	. .	. .	. .	*0.1*	. .	0.2	0.2	. .	. .	. .	. .
	3928.0	0	1	2	2	2	.	.	4	0.5	0.5	. .	. .	0.3	. .	. .	. .	. .	. .	. .	0.6	0.1	. .	. .	. .	. .
	3930.3	0	1	1					2	0.8	0.8	0.4	0.1	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
K	3933.8	5	8	13	135	160	200	170	5	0.3	0.4	0.2	0.0	0.4	0.0	1.3	. .	. .	0.2	. .	0.0	0.0	. .	. .	. .	. .
	3936.0	0	1	?					2	0.0	. .	0.3	0.1	0.7	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	3938.5	0	2	2	2	2	.	.	3	0.1	0.3	0.1	0.0	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	3941.4	0	0	0	1	2	.	.	3 g	. .	. .	. .	. .	0.3	. .	. .	. .	. .	0.1	. .	0.2	*0.1*	. .	. .	. .	. .
	3944.1	0	0	?	2	3	3	.	4	. .	. .	. .	. .	*0.6*	*0.3*	. .	. .	. .	. .	. .	0.7	0.3	*1.4*	0.2	. .	. .

Desig.	Wave Length.	VI.	VII.	VIII.	XII.	XIV.	XV.	XVIII.	S. S.	470	484	1486	1507	387	493	1066	453	1717	506	634	388	429	401	475	1498	1504
	3945.2	0	2	2	2	3	3	.	2 d	*0.4*	*0.3*	0.2	0.0	*1.1*	..	..	..	..	*0.1*	..	..	0.3	*0.6*	..	..	..
	3947.7	0	0	0	0	2	2	.	2 g	..	..	..	..	..	..	..	..	..	..	..	..	..	0.2	..	..	..
	3949.0	0	1	1	2	2	2	.	3 d	*0.1*	..	..	..	*0.8*	0.0	..	..	..	0.0	..	0.0	0.3	*0.1*	*0.4*	..	..
	3950.0	0	0	0	1	1	1	.	2	..	..	..	..	*0.5*	0.2	..	..	..	0.8	..	..	0.4	0.2	..	..	..
	3951.3	0	0	0	?	0	0	.	2	..	..	..	..	*0.5*	0.1	..	..	..	..	..	..	..	..	..	..	..
	3953.0	0	1	1	2	7	7	.	4 g	*0.4*	..	*0.6*	*0.9*	0.5	0.1	..	..	..	*0.3*	..	0.4	0.3	0.4	0.2	..	..
	3956.6	0	1	2	3	4	4	.	3 g	0.5	..	..	..	0.5	0.2	..	..	..	0.1	..	0.1	0.4	0.2	0.1	..	..
	3958.4	0	0	0	2	2	3	.	2	..	..	..	..	0.3	0.5	..	..	..	0.2	..	0.0	0.4	0.2	0.2	..	..
	3961.6	0	2	2	2	6	6	.	4	*0.4*	..	*0.1*	*0.3*	0.5	0.3	..	..	..	0.2	..	0.7	0.4	0.0	0.6	..	..
	3963.4	0	0	0	1	?		.	2	..	..	..	..	0.1	0.1	..	..	..	0.4	..	..	0.7	*0.5*	..	..	..
	3964.5	0	0	0	0	?		.	2 d	..	..	0.3	*0.1*	..	..	..	..	..	..	..	..	..	..	..	..	..
H	3968.6	70	6	70	100	120	170	140	5	..	..	0.1	0.3	0.8	1.0	..	..	..	0.6	..	0.2	*0.2*	*0.4*	0.2	..	..
Hε	3970.2		65							*0.2*	*0.5*	0.4	0.4	..	..	3.2	0.1	1.5	..	..	..	..	..	..	..	..
	3973.8	0	0	0	?	1		.	2	..	..	0.5	..	..	..	..	..	..	..	..	..	..	0.2	..	..	..
	3974.7	0	0	0	1	2		.	3 d	..	..	..	..	0.1	0.0	..	..	..	..	..	0.0	*0.2*	0.4	..	..	..
	3976.8	0	0	0	1	2	2	1	2	..	..	..	..	0.4	0.3	..	..	..	0.0	..	*0.2*	0 2	*0.1*	0.1	..	..
	3978.7	0	0	0	?	1	1	0	1 g	..	..	..	..	0.0	*0.2*	..	..	..	..	..	*0.3*	*0.2*	*0.1*	*0.1*	..	..
	3979.7	0	0	0	1	1	1	1	1 d	..	..	0.2	0.1	0.5	0.3	..	..	..	..	..	*0.1*	*0.2*	0.2	0.0	*0.7*	..
	3982.0	0	?	1	1	3	2	4	2 d	..	..	0.1	0.3	0.7	0.0	..	..	..	0.3	0.4	0.0	*0.1*	0.3	*0.1*	0.1	..
	3982.7	0	0	0	0	0	1	0	1 d	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*0.2*	..	..
	3984.1	0	0	0	1	2	1	?	2 d	..	..	..	..	..	0.0	..	..	..	..	..	0.0	0.1	0.1	0.2	..	..
	3985.5	0	0	0	1	?	1	0	2	..	..	..	..	*1.0*	*0.2*	..	..	..	..	..	..	..	0.0	0.0	..	..
	3987.0	0	0	?	2	3	3	1	3 d	*0.2*	..	..	..	0.4	*0.1*	..	..	..	0.5	..	*0.3*	0.5	0.3	0.3	..	..
	3990.0	0	0	0	2	3	4	4	3	..	..	..	..	*0.7*	0.0	..	..	..	0.4	1.2	*0.7*	0.4	0.1	0.3	*0.1*	..
	3991.6	0	0	0	1	1	0	2	2 d	..	..	..	..	*1.0*	*0.5*	..	..	0.6	0.4	..	..	0.4	..	..	..	..
	3993.0	0	0	0	0	?	2	?	1	..	..	..	..	*0.8*	*0.5*	..	..	..	..	..	..	..	*0.8*	*0.9*	..	..
	3994.2	0	0	0	1	1	1	2	2 d	..	..	..	..	0.4	0.1	..	..	..	0.1	..	*0.3*	*0.3*	*0.4*	*0.1*	..	..
	3994.8	0	0	0	0	0	?	?	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0.0	..	..
	3995.5	0	0	0	1	1	1	1	3	..	..	..	..	0.8	0.2	..	..	0.3	0.4	..	..	..	..	0.0	..	..
	3997.6	0	1	1	2	2	1	?	3	0.2	*0.8*	..	*0.3*	0.2	0.1	..	..	..	0.1	0.0	..	..	..	*1.3*	..	..
	3998.1	0	0	0	0		1		3 d	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*1.0*	..	..
	3998.8	0	0	0	2	2	2	4	2	..	..	..	..	0.5	0.0	*0.1*	..	0.2	0.3	..	0.0	..	0.8	0.2	*0.3*	..
	4000.5	0	0	0	1	1	1	?	3 d	..	..	..	..	0.4	0.3	..	..	..	0.3	..	0.2	0.0	*0.1*	0.0	*0.2*	..
	4001.3	0	0	0	0	0	1	?	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	4001.8	0	0	0	1	1		1	2	..	..	..	..	0.4	0.4	..	..	..	..	..	0.3	*0.1*	*0.5*	*0.2*	..	..
	4003.0	0	1	1	1	?	1	0	1	0.1	*0.2*	*0.4*	*0.6*	0.4	0.2	*0.6*	*0.9*	*0.3*	..	..	0.3	*0.4*	*0.4*	*0.3*	..	..
	4003.9	0	0	0	0	0	1	0	2	..	..	..	..	..	..	..	..	..	..	..	..	..	*0.2*	*0.1*	0.0	..
	4005.3	0	2	3	3	6	7	5	5	0.1	0.3	0.5	0.2	0.2	0.1	*0.2*	2.4	0.5	0.3	*0.2*	0.3	0.0	*0.1*	0.2	..	..
	4006.9	0	0	0	3	1	1	0	3 d	..	..	..	..	0.2	*0.2*	..	..	..	..	..	..	0.0	..	0.9	..	..
	4009.0	0	0	0	0	0	1	0	3	..	..	..	..	..	..	..	..	..	..	..	..	..	*0.3*	0.0	..	..
	4009.9	0	0	0	?	1	1	3	3	..	..	..	..	0.3	*0.2*	..	..	..	..	..	*0.2*	*0.2*	*0.3*	*0.1*	..	..
	4010.9	0	0	0		1	1		2 g	..	..	..	..	..	..	..	..	..	..	..	..	*0.2*	0.3	..	..	..
	4011.6	0	0	0	0	0	0	3	2 d	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	4012.6	0	1	1	1	2	2		3	*0.1*	*0.1*	*0.1*	*0.1*	0.1	*0.1*	*0.7*	..	*0.3*	*0.1*	*0.9*	*0.5*	0.0	*0.1*	*0.1*	..	..
	4013.9	0	0	0	1	2	1	2	3 d	..	..	..	..	..	*0.3*	..	..	..	..	..	..	..	..	*0.4*	*0.2*	..
	4014.7	0	0	0	0	?	1		3	..	..	..	..	..	*0.1*	0.0	..	*0.1*	0.1	0.1	*0.3*	*0.2*	*0.4*	*0.5*	..	..
	4015.2	0	0	1	0	0	0	0	0	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	4015.8	0	0	?	1	1	1	0	2	..	..	*0.4*	*0.5*	0.1	*0.4*	..	..	..	..	..	..	..	*0.2*	*0.4*	0.8	..

Desig.	Wave Length.	VI.	VII.	VIII.	XII.	XIV.	XV.	XVIII.	S. S.	470 484	1486 1507	387 438	1066	453 1717	505 634	383 429	401 475	1498 1504
	4017.4	0	0	0	2	1	1	0	3	. . . .	. . . .	. . *0.1*	. .	. . . .	. . . .	0.2 . .	*0.6* *0.1*	. . . .
	4018.4	0	0	0	2	2	2	3	3 d	. . . .	. . . .	*0.3* 0.0	. .	1.1 *0.4*	*0.6* *0.5*	0.0 *0.5*	*0.4* *0.4*	*0.7* *0.2*
	4019.2	0	0	0	0	0	1	1	1	. . . .	. . . .	. . . .	. .	. . . .	. . . .	. . . .	0.1 *0.1*	*1.3* . .
	4020.4	0	0	0	0	2	2	3	3 g	. . . .	. . . .	. . . .	. .	. . . .	. . . .	0.1 0.1	0.1 0.0	. . . .
	4022.0	0	0	0	1	2	2	3	3	. . . .	. . . .	0.3 *0.2*	. .	. . *0.5*	*0.1* *0.8*	0.2 0.1	*0.2* *0.1*	*1.1* *0.5*
	4023.5	0	0	0	1	0	1	2	2	. . . .	. . . .	0.0 *0.1*	. .	. . . .	0.1 . .	. . . .	. . *0.1*	. . . .
	4024.8	0	1	1	2	3	3	3	3 d	*0.3* *0.5*	*0.4* 0.0	0.4 0.1	0.0	1.6 0.5	0.2 *0.6*	0.1 0.0	0.3 0.1	*0.5* 0.3
	4027.2	0	0	0	0	0	1	2	2	. . . .	. . . .	. . . .	. .	. . . .	. . . .	. . *0.4*	*0.5* *0.2*	*0.2* 0.1
	4028.5	0	1	1	1	1	1	1	3	*0.3* *0.5*	0.0 0.1	0.1 *0.2*	*0.4*	*0.4* 0.0	*0.2* *0.9*	. . . .	*0.4* 0.0	*0.1* 0.8
	4030.8	0	1	1	2	3	5	8	4 d	*0.5* . .	. . . .	. . 0.0	*0.6*	0.8 *0.5*	0.0 *0.4*	0.0 *0.1*	*0.2* *0.1*	0.1 *0.2*
	4033.2	0	1	1	2	2	3	4	4	. . . .	0.2 *0.1*	*0.1* 0.0	*0.7*	. . . .	*1.4* 0.5	*0.4* 0.0	*0.3* *0.3*	*0.1* . .
	4034.6	0	0	0	1	1	2	5	4	. . . .	. . . .	*0.1* 0.0	*0.2*	. . . .	0.2 . .	*0.7* 0.0	0.0 *0.2*	*0.4* *0.1*
	4035.8	0	0	?	1	1	2	2	4	. . . .	. . *0.1*	0.2 0.0	*0.3*	0.1 . .	0.2 0.7	*0.6* 0.1	0.0 *0.2*	*0.2* 0.0
	4037.3	0	0	0	1	?	0	0	1	. . . .	. . . .	*0.2* *0.2*	0.4	. . . .	. . . .	. . 0.3	. . . .	. . . .
	4039.0	0	0	0	1	1	1	?	2 g	. . . .	. . . .	0.1 *0.1*	. .	. . . .	. . . .	. . . .	*0.4* *0.4*	. . *1.0*
	4040.8	0	0	0	0	?	?	0	2	. . . .	. . . .	. . . .	*0.8*	*0.9* *0.3*	. . *0.4*	. . . .	. . . .	. . . .
	4041.5	0	0	1	2	2	2	5	3	*0.4* *0.4*	. . *0.2*	0.0 *0.1*	. .	. . . .	*0.4* . .	*0.2* *0.3*	*0.6* *0.5*	*0.2* *0.3*
	4044.0	0	0	0	?	1	1	1	3	. . . .	. . . .	. . 0.4	. .	. . *1.0*	*0.1* .	. . *0.1*	*1.0* *1.3*	*0.3* . .
	4045.9	1	2	3	5	10	13	7	5	*0.2* 0.2	*0.1* *0.3*	0.2 0.1	*0.4*	0.0 *0.2*	0.1 *1.1*	0.1 0.0	0.0 *0.1*	0.0 *0.2*
	4047.4	0	0	0	1	0	0	1	2	. . . .	. . . .	. . *0.3*	. .	. . . .	. . . .	. . . .	. . . .	*0.1* . .
	4048.9	0	1	1	1	2	?	1	3	0.3 0.0	*0.2* *0.1*	0.3 0.1	*0.8*	*0.4* *0.6*	0.1 *0.3*	0.4 0.1	. . . .	*0.4* 0.4
	4049.7	0	0	0	0	0	1	?	2 g	. . . .	. . . .	. . . .	. .	. . . .	. . . .	. . . .	0.4 *0.5*	. . . .
	4050.8	0	0	0	1	1	1	1	2	. . . .	. . . .	0.2 *0.4*	0.3	. . . .	*0.2* . .	. . 0.2	0.2 0.1	0.1 0.7
	4052.6	0	0	0	1	2	2	?	3 g	. . . .	*0.8* *0.6*	*0.1* *0.2*	. .	. . 0.4	*0.4* . .	*0.1* 0.0	0.0 *0.2*	*0.4* . .
	4054.0	?	1	1	1	0	0	0	2 g	0.1 . .	*0.2* *0.1*	0.1 *0.1*	*0.5*	. . . .	. . . .	. . . .	. . . .	. . . .
	4055.0	0	0	0	1	2	3	6	3 d	. . . .	. . . .	0.5 0.0	. .	. . . .	. . . .	0.0 0.1	*0.3* *0.3*	*0.1* *0.1*
	4057.6	?	?	1	2	2	2	3	4 d	0.6 1.2	*0.1* . .	0.3 *0.1*	0.4	*0.3* . .	0.0 . .	0.7 *0.3*	0.0 *1.6*	*0.6* . .
	4059.0	0	0	0	1	1	2	2	3 d	. . . .	. . . .	0.5 *0.2*	. .	2.0 0.2	. . . .	. . 1.0	0.1 *1.0*	2.4 *0.4*
	4063.7	1	2	3	3	7	10	10	5	*0.3* *0.1*	0.1 *0.1*	0.1 *0.1*	*0.5*	*0.1* 0.1	*0.2* *1.6*	0.2 *0.1*	0.1 0.1	0.4 *0.1*
	4065.4	0	0	0	1	0	0	0	2	. . . .	. . . .	0.2 *0.4*	. .	. . . .	. . . .	. . . .	. . . .	. . . .
	4067.0	1	2	2	2	6	3	4	3 g	*1.1* 0.3	*0.1* 0.0	. . 0.3	0.1	0.5 0.6	0.2 *0.7*	0.3 0.1	0.0 *0.1*	0.5 0.4
	4068.2	0	0	0	1	0			3	. . . .	. . . .	*0.8* *0.1*	. .	. . . .	. . . .	. . . .	. . . .	. . . .
	4069.4	0	0	0	0	1	1	1	1	. . . .	. . . .	. . . .	. .	. . . .	. . . .	. . *0.1*	*0.3* *0.5*	*0.1* . .
	4071.9	1	2	3	3	7	8	8	4	. . *0.3*	0.0 *0.3*	0.2 0.0	*0.2*	0.1 0.3	*0.1* *0.9*	*0.2* *0.1*	0.0 0.0	0.1 0.0
	4072.7	0	0	0	0	0	0	2	2	. . . .	. . . .	. . . .	. .	. . . .	. . . .	. . . .	0.0 0.7	1.1 . .
	4075.0	0	0	0	1	1	1	2	3 g	. . . .	. . . .	0.1 0.0	. .	. . 0.4	0.8 . .	. . 0.1	*0.4* *0.2*	*0.1* 0.3
	4076.8	0	0	0	1	1	3	3	4 g	. . . .	. . . .	*0.1* *0.3*	. .	. . . .	. . . .	. . . .	0.0 *0.3*	. . . .
	4077.9	1	2	3	3	7	4	5	4	1.1 *0.2*	. . *0.2*	0.1 *0.1*	*0.5*	*0.5* *0.8*	*0.1* *1.6*	*0.2* *0.1*	*0.1* *0.4*	0.0 0.2
	4079.5	0	0	0	1	1	2	2	3 d	. . . .	. . . .	0.3 0.2	. .	. . . .	. . . .	. . 0.3	0.4 *0.2*	. . . .
	4081.2	0	0	0	0	0	?	2	2 d	. . . .	. . . .	. . . .	. .	. . . .	. . . .	. . . .	. . . .	0.3 0.0
	4082.4	0	0	0	0	1	2	5	2 d	. . . .	. . . .	. . . .	. .	. . . .	. . . .	. . . .	. . *0.3*	. . . .
	4083.8	0	0	0	1	2	2		3	. . . .	. . . .	*0.2* *0.3*	0.4	*0.5* *0.2*	*0.4* *2.0*	*0.5* *0.5*	*0.6* *0.3*	*0.6* *0.4*
	4085.4	0	0	?	2	2	2	2	3	. . . .	. . . .	*0.2* *0.1*	. .	. . . .	*0.3* *0.2*	0.5 0.1	0.0 *0.2*	. . 0.4
	4086.8	0	0	0	1	2	2	3	2 g	. . . .	. . . .	0.2 0.0	0.5	1.0 0.2	0.3 . .	. . 0.2	0.1 *0.2*	*0.3* 0.4
	4089.0	0	0	0	?	?	1	1	2 d	. . . .	. . . .	0.2 *0.3*	. .	. . . .	. . . .	. . 0.1	*0.3* *0.6*	0.0 *0.1*
	4090.2	0	0	0	0	1	2	3	2	. . . .	. . . .	. . . .	. .	*0.5* 0.8	0.3 *1.0*	0.0 0.5	0.5 0.3	0.7 0.5
	4092.7	0	0	0	2	3	3	3	4 g	. . . .	. . . .	0.1 *0.2*	. .	0.1 0.0	0.2 *1.4*	*0.3* 0.0	0.1 0.0	0.2 0.2
	4095.0	0	0	0	0	1	0	0	2	. . . .	. . . .	*0.1* . .	. .	. . . .	. . . .	. . *0.4*	. . . .	. . . .
	4096.2	0	0	0	1		2	4	3	. . . .	. . . .	. . *0.4*	. .	0.3 0.2	0.5 *1.3*		0.2 *0.2*	0.2 0.0

Desig.	Wave Length.	VI.	VII.	VIII.	XII.	XIV.	XV.	XVIII.	S. S.	470	484	1486	1507	387	498	.086	453	1717	505	634	393	429	401	475	1498	1504
	4097.3	0	0	0	1	2	2	?	3	..	..	..	..	*0.9*	*0.2*	..	..	..	..	..	*1.0*	*0.9*	..	*0.3*	..	..
	4098.5	0	0	0	1	1	1	1	3 d	..	..	..	..	0.6	0.0	..	0.0	0.5	0.2	*1.5*	0.0	0.2	0.3	*0.2*	*0.3*	0.0
	4100.2	0	0	0	0	0	0	2	3 d	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*0.5*	..
	4100.9	0	0	0	0	0	2	2	2	..	..	..	..	..	..	..	..	..	..	..	..	..	*0.2*	..	..	..
Hδ	4101.8	65	65	60	16	10	6	4	5	0.3	*0.1*	0.0	0.0	0.4	0.4	*0.4*	0.0	0.7	*0.3*	*1.4*	0.2	0.2	*0.2*	*0.3*	0.2	*0.6*
	4103.1	0	0	0	0	0	1	?	2	..	..	..	..	..	..	..	..	..	..	..	..	..	0.4	0.2	0.2	..
	4104.3	0	0	0	0	2	0	0	2	..	..	..	..	..	..	..	..	..	0.1	..	0.2	0.7	..	..	..	..
	4105.3	0	0	0	0	0	3	3	2 d	..	..	..	..	..	..	..	..	..	..	0.5	..	..	*0.2*	*0.4*	*0.1*	*0.5*
	4106.6	0	0	0	?	1	2	1	2 d	..	..	..	..	*0.1*	0.1	..	0.1	1.1	..	..	..	*0.5*	0.0	*0.3*	0.1	1.0
	4107.7	0	0	0	?	1	1	1	2	..	..	..	..	0.2	0.0	..	..	..	..	..	0.0	0.2	0.1	*0.2*	..	..
	4108.9	0	0	0	0	0	1		2	..	..	..	..	..	..	..	..	..	..	*0.2*	..	..	*0.4*	*0.5*	*0.5*	..
	4110.0	0	0	0	?	2	1	4	3	..	..	..	..	0.1	0.0	..	0.3	*0.3*	*0.3*	..	*0.4*	*0.6*	0.3	*0.2*	0.1	*0.1*
	4110.8	0	0	0			1		2	..	..	0.6	0.5	..	..	0.3			..	..	..	..	..	0.1	..	..
	4112.0	0	0	0	?	2	2	1	2	..	..	..	..	*0.2*	0.0	..	..	..	*0.5*	..	..	..	..	*0.2*	..	..
	4113.1	0	0	0	1		2	4	2	..	..	..	..	0.3	0.1	0.3	..	0.2	0.5	*0.3*	*0.2*	*0.2*	*0.6*	*0.4*	*0.6*	*0.7*
	4114.6	0	0	0	0	?	0	1	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*0.8*	0.3
	4115.3	0	0	0	1	1	1	2	2 d	..	..	..	..	*0.2*	*0.6*	..	*0.9*	*0.3*	..	..	*0.4*	*0.2*	0.0	0.1	0.0	..
	4116.8	0	0	0	1	1	2	2	2	..	..	..	..	..	*0.3*	..	..	..	..	..	*0.2*	0.8	*0.1*	0.1	0.0	0.1
	4118.9	1	1	1	2	3	3	3	4 d	*0.3*	0.3	..	..	0.4	*0.3*	0.3	0.3	0.5	*0.1*	*1.6*	0.5	0.3	0.2	0.2	0.2	0.0
	4120.4	0	0	0	1	1	?	0	2	..	..	..	..	..	0.2	..	..	..	..	..	..	..	..	..	..	..
	4121.8	0	0	0	1	1	2	3	3 d	..	..	..	..	*0.6*	0.1	..	..	..	..	..	0.2	0.6	0.3	0.2	*0.1*	*0.2*
	4122.8	1	1	1	1		0	0	2 d	0.4	0.0	0.1	0.2	..	0.1	*0.1*	0.3	0.7	0.7	*1.2*	..	..	..	..	..	..
	4123.9	0	0	0	1	2	3	3	2	..	..	..	..	0.1	0.0	..	..	..	..	..	*0.3*	*0.1*	0.0	0.0	0.0	*0.2*
	4126.1	0	0	0	1	1	2	1	3 g	..	..	..	..	0.1	0.0	..	..	..	..	..	*0.1*	0.1	0.1	0.4	0.2	*0.2*
	4128.1	0	0	2	2	2	3	3	3 g	*1.6*	0.4	0.3	0.4	0.1	*0.1*	0.1	0.4	1.0	0.7	*0.7*	0.0	0.0	..	0.0	0.2	0.1
	4128.5	2	3	?	0	0	0	0	0	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	4129.8	0	0	0	1	1	2	3	2 g	..	..	..	..	..	*0.2*	0.5	..	..	..	..	0.4	0.5	0.2	0.5	0.3	0.7
	4131.4	3	2	1	1	0	0	0	1	*0.3*	*0.5*	*0.3*	*0.3*	..	*0.5*	..	..	..	..	..	..	..	..	..	..	..
	4132.2	0	?	1	2	4	4	3	4	0.3	0.2	..	..	0.5	0.2	0.5	0.6	0.9	0.3	*0.2*	0.5	0.6	0.4	0.4	0.4	0.4
	4134.8	0	0	1	1	3	4	4	4 d	0.7	0.2	..	..	0.1	*0.2*	..	0.0	0.2	0.2	1.6	*0.1*	0.2	0.1	0.0	0.1	0.0
	4137.4	0	0	1	1	2	2	2	3 g	0.4	0.5	..	..	0.6	0.4	*0.1*	0.9	0.8	0.3	..	0.7	0.7	0.3	0.2	0.3	0.2
	4140.3	0	0	0	1	1	2	3	2	..	..	..	..	0.5	0.0	..	..	..	..	..	*0.1*	0.4	0.0	0.5	0.0	*0.2*
	4142.5	0	0	0	1	1	13	0	2 g	..	..	..	..	0.1	*0.3*	..	..	..	..	..	..	..	..	..	..	..
	4143.9	2	1	2	3	5		8	4 d	0.0	*0.1*	*0.2*	*0.7*	0.2	0.0	*0.3*	*0.4*	*0.2*	*0.1*	*2.0*	*0.1*	0.6	*0.3*	*0.2*	0.2	0.3
	4146.1	0	0	0	0	1	1	1	2 d	..	..	..	..	..	..	..	..	..	0.3	*0.4*	..	..	0.2	0.1	0.3	..
	4147.9	0	0	0	1	1	1	2	2	..	..	..	..	0.2	*0.2*	..	..	..	0.2	..	*0.3*	0.1	0.1	*0.2*	0.0	*0.5*
	4149.5	0	?	1	1	3	4	5	3 d	0.3	*0.2*	..	..	..	0.0	0.0	0.5	0.2	..	..	0.2	0.2	0.1	0.2	0.3	0.1
	4150.5	0	0	0	1				2	..	..	..	..	*0.3*	0.5	..	..	..	..	..						
	4152.2	0	0	0	1	2	3	3	3	..	..	..	..	0.4	0.0	..	..	..	0.2	0.6	0.6	0.6	0.4	0.4	0.5	0.2
	4154.1	0	1	1	1	3	0	0	3	0.2	0.3	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	4154.9	0			1		3	3	3 d			..	..	0.2	*0.3*	*0.3*	*0.4*	*0.2*	*0.2*	0.0	*0.2*	0.0	*0.1*	*0.2*	*0.3*	*0.3*
	4156.7	0	0	0	2	3	3	3	3 g	..	..	..	..	0.5	*0.2*	0.0	0.2	0.2	0.1	0.5	0.4	0.6	0.2	0.5	0.0	*0.1*
	4158.0	0	0	0	?	?	1	?	2	..	..	..	..	..	0.2	..	..	..	..	..	..	..	0.1	0.2	0.2	..
	4159.2	0	0	0	1	1	0	2	3 d	..	..	..	..	0.3	0.1	..	..	..	0.2	0.6	..	0.2	0.1	..	0.7	*0.2*
	4160.2	0	0	0	0	0	1	0	1 g	..	..	..	..	..	..	..	..	..	..	..	..	..	0.1	*0.2*	..	..
	4161.7	0	0	1	2	2	2	2	2	*0.9*	*0.1*	..	..	0.1	*0.2*	*0.6*	*0.1*	0.1	0.2	0.3	*0.1*	0.0	0.1	0.3	*0.3*	0.3
	4163.9	0	1	1	1	1	?	0	2	0.1	*0.6*	0.1	0.2	0.4	0.1	*0.1*	0.1	0.0	0.3	0.3	0.5	0.5	..	..	..	..
	4165.6	0	0	0	1	1	2	3	2	..	..	..	..	0.1	*0.1*	..	..	..	0.5	0.2	0.3	0.1	*0.3*	*0.4*	*0.9*	*0.5*
	4167.5	0	?	1	2	2	2	2	3	*0.2*	0.4	..	..	0.4	*0.1*	0.0	*0.8*	*1.4*	0.3	1.4	0.3	0.1	0.2	0.2	0.5	0.4

Desig.	Wave Length.	VI.	VII.	VIII.	XII.	XIV.	XV.	XVIII.	S. S.	470 484	1486 1507	387 498	1086	453 1717	505 634	393 429	401 475	1493 1504
	4169.8	0	0	0	?	?	1	2	1 d	. . . .	. . . .	*0.3* . .	. .	. . . .	. . . .	. . 0.5	0.1 *0.3*	*0.1 0.1*
	4171.2	0	0	0	1	0	0	0	3 d	. . . .	. . . .	. . . .	. .	. . . .	. . . .	. . . .	. . *0.2*	. . . .
	4172.3	1	1	2	2		5		2 d	*3.7* . .	. . . .	. . *0.1*	. .	. . . .	. . . .	. . . .	0.2 0.2	. . . .
	4172.9	0	0	?	?	5		12	3	. . . .	*0.7* . .	. . . .	. .	. . . .	*0.5 1.3*	0.0 0.0		*0.3 0.3*
	4173.6	1	1	2	3		?		2	0.0 *0.2*	0.2 0.3	*0.6* 0.1	*0.6*	*0.5 0.2*	0.3 0.0	0.6 . .	. . 0.4	0.4 0.3
	4175.1	0	0	0	0	?	1	3	2	. . . .	. . . .	. . . .	. .	. . . .	. . . .	0.4 1.0	0.6 0.2	0.2 0.4
	4177.8	0	1	3	2	2	3	2	3	0.3 0.7	0.2 . .	0.1 *0.1*	0.1	0.1 0.2	0.1 . .	0.6 0.4	0.4 0.3	*1.0* 0.0
	4179.5	1	2		2	1	1	1	2		*0.4 0.2*	0.0 *0.2*			*0.3* 1.0	. . 0.2	. . 0.1	0.1 . .
	4182.0	0	1	1	2	2	2	2	2	0.1 0.1	. . . .	0.3 0.2	. .	0.0 0.6	0.3 0.6	0.2 0.7	*0.1* 0.8	0.3 0.1
	4184.2	0	1	1	2	2	?	0	2	0.0 0.1	. . . .	. . 0.2	. .	. . . .	. . . .	0.0 0.3	0.0 . .	. . . .
	4185.0	0	0	0	0	0	1	2	2	. . . .	. . . .	. . . .	*0.5*	*0.7 0.2*	*0.2* 0.5	. . . .	. . . .	*0.3 0.6*
	4187.6	0	2	2	2	4	4	5	4 g	0.5 *0.9*	. . 0.6	0.2 0.3	*0.1*	*0.3* 0.0	0.0 . .	0.1 0.2	0.0 0.2	*0.1* 0.1
	4189.0	0	0	0	1	0	0	0	2	. . . .	. . . .	*0.1* 0.0	. .	. . . .	. . 0.6	. . . .	. . . .	. . . .
	4191.8	0	1	1	2	3	3	. 6	3 d	0.8 0.3	. . . .	0.1 *0.1*	*0.7*	*0.3 0.2*	*0.2* . .	0.0 0.2	*0.2* 0.0	*0.4 0.3*
	4194.0	0	0	0	0	?	1	0	1 d	. . . .	. . . .	. . . .	. .	. . . .	. . . .	. . 0.5	*0.3 0.2*	. . . .
	4195.6	0	1	1	2	3	1	1	3 d	0.2 0.3	. . . .	0.0 *0.2*	. .	0.0 *0.4*	*0.1* 0.5	0.1 0.5	*0.1 0.3*	0.1 *0.1*
	4196.8	0	0	0			2	1	2 d	. . . .	. . . .						0.1 0.1	0.6 0.1
	4198.5	0	1	3	3	3	2	1	4 g	0.0 0.5	. . . .	0.2 0.2	0.6	0.5 0.1	0.3 . .	0.2 0.3	0.1 0.0	. . . .
	4200.9	0	0	0	0	0	1	2	3 g	. . . .	. . . .	. . . .	. .	. . . .	. . *0.5*	. . . .	*0.4 0.4*	*0.7 1.0*
	4202.2	0	1	2	2	3	3	1	4	*0.1* 0.2	. . 0.1	0.0 0.1	*0.1*	*0.1 0.2*	0.2 1.0	0.1 0.2	0.1 0.1	0.2 0.0
	4204.2	0	0	0	1	0	0	1	2	. . . .	. . . .	. . *0.4*	. .	. . . .	. . . .	. . . .	. . . .	*0.2* . .
	4205.3	0	0	1	1	2	2	2	2	0.0 *0.5*	. . . .	0.1 *0.2*	*0.4*	0.0 *0.5*	*0.2 0.1*	*0.1* 0.1	*0.2 0.1*	0.0 *0.1*
	4206.9	0	0	0	1	1	1	3	2	. . . .	. . . .	0.4 0.1	. .	. . 0.1	0.3 1.4	0.3 0.2	*0.2* 0.0	0.2 0.1
	4208.8	0	0	0	1	0	1	1	2	. . . .	. . . .	. . *0.1*	. .	. . *0.3*	0.2 . .	. . 0.2	*0.4 0.3*	. . 0.1
	4210.5	0	0	1	1	2	2	1	3	0.4 . .	. . . .	*0.2 0.1*	. .	*0.4* . .	*0.1* . .	. . . .	*0.4 0.3*	*0.1 0.4*
	4212.1	0	0	0	1	0	1	1	2	. . . .	. . . .	*0.4* 0.0	. .	. . . .	*0.1* . .	. . . .	*0.9 0.3*	*0.2 0.3*
	4213.9	0	0	0	1	1	1	1	2	. . . .	. . . .	*0.1 0.2*	. .	. . . .	. . . .	0.2 *0.3*	*0.3 0.2*	0.1 *0.1*
	4215.7	0	1	2	3	5	7	9	3	*0.2 0.3*	1.3 *0.1*	0.1 *0.3*	0.0	0.1 0.1	0.0 *0.4*	0.3 0.4	0.4 0.4	0.4 0.3
	4217.6	0	0	0	2	1	1	1	3 d	. . . .	. . . .	0.2 *0.2*	. .	0.2 . .	0.2 0.3	0.1 . .	0.3 *0.1*	0.4 0.3
	4219.6	0	0	0	2	2	1	0	3	. . . .	. . . .	0.2 *0.5*	. .	0.3 0.3	0.5 0.8	*0.1* 0.0	0.0 *0.1*	*0.5 0.4*
	4220.5	0	0	0				1	2	. . . .	0.7 . .			. . . .	. . . .		0.2	0.1 0.1
	4222.4	0	0	0	1	1			3	. . . .	. . . .	0.3 *0.1*	. .	0.1 0.1	0.4 . .	0.5 0.2	. . . .	*0.3 0.1*
	4223.7	0	0	0	0	?	2	3	2	. . . .	. . . .	. . . .	. .	. . . .	. . . .	. . . .	*1.2 0.5*	. . . .
	4224.7	0	0	0	0	1			3 g	. . . .	. . 0.5	. . . .	. .	*0.3* 0.7	0.5 0.5	0.1 . .	0.0 . .	. . . .
	4227.0	1	1	2	7	10	20	40	5 d	0.0 0.6	. . . .	0.1 0.2	*0.2*	0.0 *0.3*	0.0 0.8	0.1 0.1	0.1 0.1	*1.3 0.4*
	4229.9	0	0	0	0	1	2	3	3	. . . .	. . . .	. . . .	. .	. . . .	0.1 1.3	0.3 0.0	0.0 0.3	0.2 0.7
	4233.6	2	2	3	3	3	3	6	4 g	*0.3 0.3*	*0.4 0.5*	0.0 *0.1*	*0.3*	*0.5 0.4*	*0.2* . .	0.0 *0.1*	0.1 0.0	0.0 *0.3*
	4236.0	0	0	1	1	2	2	2	4	*0.1* 0.3	. . . .	0.3 *0.1*	*0.1*	0.1 0.0	0.2 . .	*0.2* 0.2	0.4 . .	*0.5 0.6*
	4237.3	0	0	0	0	0	1	1	3	. . . .	. . . .	. . . .	. .	. . . .	. . . .	. . . .	0.6 *0.1*	. . . .
	4239.0	0	0	0	0	0	0		3	0.3 0.2	. . . .	. . . .	. .	. . . .	. . . .	. . . .	. . . .	. . . .
	4240.0	0	0	0	2	2	2	8	3 d	. . . .	. . . .	0.2 0.0	0.1	*1.0 0.8*	*1.5 1.1*	0.1 *0.1*	0.4 0.5	*0.8 0.5*
	4242.5	0	1	1	1	2	1	1	3 g	0.3 0.1	*0.3 0.1*	0.1 0.1	*0.2*	0.1 *0.1*	0.1 *1.2*	*0.1* 0.1	. . . .	. . . .
	4243.6	0	0	0	1		2	1	3	. . . .	. . . .		. .	. . . .	. . . .		*0.5 0.3*	*0.3* 0.3
	4245.5	0	0	0	1	0	1	1	3	0.1 . .	. . . .	*0.3 0.2*	. .	. . . .	. . . .	. . . .	*0.1* 0.2	0.2 . .
	4247.3	0	1	1	2	1	1	4	3	0.4 0.0	*0.5 0.2*	0.2 *0.1*	*0.7*	*0.6 0.3*	0.1 . .	0.3 0.4	0.1 0.0	*0.2 0.3*
	4248.7	0	0	1	1	1	1	1	3 g	. . . .	. . . .	. . . .	. .	. . . .	. . *0.1*	. . . .	*0.2 0.1*	*0.2 0.3*
	4251.0	0	1	2	3	3	4	4	4	*0.7 0.3*	. . *0.6*	*0.3 0.6*	*0.6*	*0.7 0.5*	*0.4* 0.2	*0.3 0.4*	*0.2 0.3*	0.2 *0.2*
	4253.0	0	0	0	0	0	1	1	1 g	. . . .	*0.3* 0.1	. . . .	*1.1*	. . . .	*0.5 0.7*	. . . .	. . *0.5*	. . . .
	4254.5	0	?	1	1	2	3	5	4	*0.1* 0.2	. . . .	. . 0.0	*0.4*	*0.1 0.3*	0.0 *0.5*	*0.1* 0.0	*0.1* 0.1	0.2 0.0

Desig.	Wave Length.	VI.	VII.	VIII.	XII.	XIV.	XV.	XVIII.	S. S.	470 484	1486 1507	387 493	1086	453 1717	505 634	383 429	401 475	1493 1504
	4255.7	0	0	0	1	2	2	1	3	. . . .	. . . .	*0.7* 0.3	. .	. . . .	. . . .	0.1 0.2	0.4 0.4	0.5 . .
	4258.7	0	1	1	1	2	2	3	3 g	*0.7* *0.5*	*0.7* *0.3*	*0.3* 0.0	*0.7*	*1.4* *0.3*	*0.1* *0.4*	*0.1* 0.0	0.1 0.0	0.0 *0.3*
	4260.5	0	1	1	2	3	3	2	4 g	*0.1* 0.2	. . . .	0.1 *0.1*	*0.1*	*0.2* 0.3	0.1 *0.2*	0.1 0.3	*0.1* 0.0	0.5 0.0
	4261.8	0	0	0	1	1	2	0	3 g	. . . .	0.3 0.2	. . 0.1	0.3	. . 0.8	0.5 1.2	. . . .	*0.1* 0.3	. . . .
	4264.4	0	0	0	0	1	1	0	2 g	. . . .	. . . .	. . . .	. .	*0.9* . .	. . . .	0.2 0.5	0.2 0.2	. . . .
	4268.0	0	0	0	?	1	2	2	3	. . . .	. . . .	0.0 . .	. .	. . . .	*1.0* *0.7*	*1.3* 0.0	*0.2* 0.2	0.6 0.5
	4270.0	0	0	0	0	1	1	0	2	. . . .	*0.4* 0.9	. . . .	*1.0*	. . *0.6*	*0.9* *0.2*	*0.4* *0.3*	*0.1* 0.0	. . . .
	4271.7	1	1	2	3	5	8	8	5 d	*0.4* *0.1*	. . . .	0.2 0.1	*0.3*	*0.6* *0.4*	0.3 *0.6*	0.1 0.1	0.1 0.3	0.3 0.2
	4273.8	0	0	0	1	0	0	0	3 g	. . . .	*0.7* *0.7*	. . *0.6*	*1.0*	. . *0.4*	*0.2* *0.6*	. . . .	. . . .	. . . .
	4275.0	0	?	1	2	3	5	6	4	0.4 0.5	0.6 1.2	0.2 0.1	0.5	0.0 0.3	0.3 1.6	0.0 0.2	0.1 0.1	0.1 *0.1*
	4277.3	0	0	0	0	1	1	1	1 g	. . . .	. . . .	. . . .	. .	. . . .	. . . .	0.0 0.4	0.0 0.2	*0.4* *0.4*
	4278.4	0	0	0	0	0	?	1	2	. . . .	. . . .	. . . .	. .	. . . .	. . . .	. . . .	. . 0.4	0.3 0.1
	4280.5	0	0	0	1	2	3	2	2 g	. . . .	. . . .	*0.2* *0.1*	. .	. . *0.2*	0.2 0.3	*0.1* 0.1	0.0 0.0	0.5 *0.2*
	4282.9	0	0	1	2	2	2	3	3 g	0.1 *0.5*	. . . .	*0.1* *0.1*	. .	*0.1* *0.1*	0.0 *0.3*	*0.2* *0.1*	*0.2* 0.0	*0.3* *0.4*
	4284.8	0	0	0	0	0	1	0	2 g	. . . .	. . . .	. . . .	. .	. . . .	. . . .	. . . .	*0.2* *0.2*	. . . .
	4286.2	0	0	0	?	2	2	1	2 g	. . . .	. . . .	*0.8* 0.7	. .	. . . .	. . . .	. . *0.3*	*0.3* . .	*0.2* *0.3*
	4288.1	0	0	?	1	?	1	1	2 d	*0.3* *0.2*	*0.4* . .	*0.3* 0.0	*0.3*	. . *0.5*	*0.1* . .	0.1 . .	*0.7* *0.1*	*0.1* *0.6*
	4289.9	1	1	2	3	4	5	6	3	0.2 0.3	0.4 0.5	0.5 . .	0.3	0.0 0.3	0.3 . .	. . 0.3	*0.2* *0.1*	*0.1* *0.1*
	4291.2	0	0	0	1	2	3	7	3 d	. . . .	. . . .	. . *1.1*	. .	. . . .	. . . .	*0.7* . .	*0.2* 0.2	*0.4* 0.1
	4292.2	0	0	0	0	0			2	. . . .	. . . .	. . . .	. .	. . . .	. . 0.6	. . . .		
	4294.3	0	1	1	1	2	2	3	3	*0.5* *0.5*	*0.1* 0.0	0.2 0.0	0.1	*0.1* 0.1	0.2 0.7	0.1 0.4	0.1 0.0	. . . .
	4296.0	0	0	0	0	0	0	1	1 d	. . . .	. . . .	. . . .	. .	. . . .	. . . .	. . . .	. . . .	0.1 0.4
	4297.1	0	0	1	1	2	1	0	2 g	*0.5* *0.5*	*0.4* *0.6*	*0.2* *0.3*	*0.6*	*0.7* *0.5*	*0.1* . .	0.1 0.0	*0.1* 0.0	. . . .
	4299.2	1	1	2	2	6	4	8	3 g	0.1 *0.2*	0.4 0.3	*0.4* 0.1	*0.1*	*0.3* *0.2*	*0.5* . .	0.1 0.0	0.1 0.2	0.1 0.1
	4300.8	0	0	0	2		4		3 g						. . . .		*0.1*	
	4302.6	1	1	2	3	3	3	4	4	*0.3* *0.4*	0.9 0.8	0.0 *0.1*	*0.2*	*0.1* 0.2	0.1 1.5	0.1 0.3	0.3 0.2	0.0 0.1
	4305.8	0	0	0	2	2	2	4	3 g	. . . .	. . . .	*0.3* *0.1*	*0.2*	*0.3* *0.5*	*0.3* 0.5	0.0 *0.1*	0.0 0.1	*0.4* 0.2
	4308.0	1	1	1	2	5	5	4	5	1.0 0.1	*0.1* 0.0	*0.2* 0.1	0.3	0.3 *0.8*	0.0 0.1	0.4 0.3	0.1 0.1	. . *0.3*
	4309.5	0	?	?	2		2	4	3 g	0.1 . .	. . . .	*0.2* *0.1*	0.7	. . *0.2*	0.1 . .	. . . .	*0.3* 0.0	1.1 0.4
	4311.7	0	0	0	0	1	1	0	2 g	. . . .	. . . .	. . . .	. .	. . . .	. . . .	. . *0.7*	*0.5*	. . . .
	4313.0	0	0	1	1	2	2	1	2 d	0.0 . .	. . . .	*0.3* *0.3*	0.0	. . . .	0.1 0.2	*0.3* *0.3*	*0.4* 0.0	*0.2* *0.1*
	4314.3	0	0	0	?	3	5	7	2 d	. . . .	. . . .	. . . .	. .	*0.2* . .	*0.1* . .	0.0 0.3	0.0 0.2	0.1 0.0
	4315.2	1	2	2	3				4	*0.2* 0.3	*0.7* *0.4*	*0.2* *0.3*	*0.5*	. . *0.5*				
	4317.0	0	0	0	0	0	1	1	1	. . . .	. . . .	. . . .	*0.2*	. . *0.2*	0.0 *0.1*	. . . .	0.2 0.2	0.7 0.2
	4318.9	0	0	0	1	1	1	2	3	. . . .	. . . .	0.2 *0.2*	. .	. . . .	. . . .	0.2 *0.4*	*0.1* 0.3	0.2 0.1
	4321.0	0	?	1	2	2	2	2	3 d	*0.2* 0.2	0.1 0.0	0.0 0.1	0.1	0.0 0.5	0.5 0.4	0.5 0.2	0.2 0.3	0.2 0.1
	4323.7	0	0	0	?	1	2	1	3 g	. . . .	. . . .	*0.6* *0.3*	. .	. . . .	. . . .	. . 0.4	0.0 0.0	*1.3* *0.5*
	4326.0	1	2	3	4	6	10	11	5	0.1 0.0	*0.3* *0.4*	*0.1* 0.1	*0.5*	*0.6* *0.1*	*0.4* *1.0*	0.0 *0.1*	0.0 0.0	0.3 0.5
	4330.9	0	0	0	2	2	2	3	2	. . . .	*0.1* . .	0.2 *0.2*	0.1	*0.3* 0.0	0.2 *1.2*	0.1 0.0	*0.4* 0.2	0.1 *0.2*
	4333.0	0	0	0	0	1	1	1	1	. . . .	. . . .	. . . .	. .	0.7 1.4	. . 0.0	. . . .	*0.3* 0.1	*0.1* *0.1*
	4334.0	0	0	0	0	0	1	1	1 g	. . . .	. . . .	. . . .	. .	. . . .	0.1 . .	0.2 0.1	0.3 0.6	0.7 0.4
	4335.2	0	0	0	0	0	0		1 g	. . . .	. . . .	. . . .	. .	. . . .	. . . .	. . . .	. . . .	. . . .
	4337.6	0	0	?	2	5	5	7	3 g	. . . .	. . . .	0.6 *0.3*	0.3	*0.2* 1.1	0.5 *0.9*	0.6 0.5	0.5 0.5	. . . .
	4339.8	0	0	0	0	0	0	0	3 d	. . . .	. . . .	. . . .	. .	. . . .	. . *0.5*	. . . .	. . . .	. . . .
H γ	4340.7	65	65	60	16	10	6	4	5	0.1 0.2	*0.2* 0.0	0.1 0.3	0.0	*0.5* 0.6	0.2 0.1	0.0 0.2	0.0 0.3	. . . .
	4343.4	0	0	0	0	0	2	0	2	. . . .	. . . .	. . . .	0.0	. . . .	. . *0.3*	. . . .	. . . .	. . . .
	4344.7	0	0	0	2	2		3	2	. . . .	. . . .	*0.3* 0.5		*0.3* *0.5*	*0.6* . .	*0.4* *0.1*	*0.2* *0.3*	0.1 0.1
	4346.8	0	0	0	0	2	2	0	2	. . . .	. . . .	. . . .	. .	. . . .	. . . .	0.0 0.6	. . . .	. . . .
	4348.0	0	0	0	?			4	2 d	. . . .	. . . .	0.2 0.2	. .	. . . .	. . . .		*0.1* *0.2*	*0.1* *0.3*

Desig.	Wave Length.	VI.	VII.	VIII.	XII.	XIV.	XV.	XVIII.	S. S.	470 484	1496 1507	387 493	1086	453 1717	505 634	383 429	401 475	1498 1504
	4352.0	2	2	3	5	5	5	5	4	0.3 0.0	0.0 0.1	0.1 0.2	0.2	*0.4* 0.1	*0.2 1.6*	0.2 0.3	0.1 0.4	0.0 0.3
	4353.0	0	0	0	0	?	1	2	3	. . . .	. . . .	. . . .	. .	. . . .	. . . .	. . . .	. . . .	*0.2* . .
	4355.3	0	0	0	1	1	1	1	2	. . . .	. . . .	0.4 0.3	. .	*0.3 0.2*	*0.7 1.2*	0.3 0.3	*0.5* . .	*0.5* 0.1
	4356.8	0	0	0	0	0	0	1	1	. . . .	. . . .	. . . .	. .	. . . .	. . . .	. . . .	*0.6 0.6*	*0.8* . .
	4358.8	0	0	0	?	3	1	2	3 d	. . . .	. . . .	. . . .	. .	. . . .	0.4 0.0	. . . .	. . . .	. . . .
	4359.9	0	0	0	2		2	3	3	. . . .	. . . .	*0.1 0.1*	0.3	*0.9 0.3*	. . . .	0.1 *0.2*	*0.1* 0.1	0.0 0.0
	4361.0	0	0	0	0	0	0	1	2	. . . .	. . . .	. . . .	. .	. . . .	. . . .	. . . .	. . . .	0.2 . .
	4362.7	0	0	0	?	2	2	1	1 d	. . . .	. . . .	0.0 *0.3*	. .	. . . .	. . . .	0.1 0.1	0.3 0.1	*0.7* . .
	4364.3	0	0	0				1	2 d	. . . .	. . . .	. . 0.2	. .	. . . .	. . . .			*0.8 0.5*
	4366.8	0	0	0	0	0	?	1	2 d	. . . .	. . . .	. . . .	. .	. . . .	. . . .	. . . .	*0.3* . .	*0.6 0.5*
	4367.9	0	0	0	2	2	3	3	3	. . . .	1.0 0.6	0.0 0.2	*0.1*	*0.3* 0.0	0.2 *0.6*	0.2 0.2	0.1 0.2	0.8 0.6
	4370.0	?	1	1	1	1	1	1	3	*0.8 0.7*	. . . .	0.0 0.1	0.1	. . . .	0.3 . .	. . *0.8*	0.4 0.3	. . . .
	4371.5	0	0	0	1	1	1	1	2	. . . .	. . . .	*0.2* 0.1	0.2	*1.4* 0.4	0.2 *0.7*	*0.3 0.4*	0.1 0.2	0.2 0.2
	4374.7	1	1	2	3	4	4	?	3 g	0.1 *0.1*	*0.7 0.7*	*0.2 0.2*	0.0	*0.2* 0.1	*0.3 0.4*	*0.1 0.1*	0.0 *0.1*	. . . .
	4376.1	0	0	0				6	3								. .	*0.2 0.4*
	4379.4	0	0	0	1	0	1	1	3	. . . .	. . . .	0.9 0.6	*1.0*	0.9 1.0	0.2 0.0	. . . .	. . 0.2	0.8 0.5
	4380.9	0	0	0	0	1	1	0	2	. . . .	. . . .	. . . .	0.1	. . . .	. . . .	*0.4* 0.1	*0.1* 0.2	. . . .
	4383.7	1	2	4	3	11	10	13	5	0.2 0.9	. . . .	0.9 0.3	0.1	0.9 . .	0.5 0.1	. . 0.0	0.4 0.9	0.1 . .
	4385.2				3		5		3 g	0.4 . .	0.4 0.2	1.3 0.1	0.2	. . 0.2		*0.4 0.1*	*0.1* . .	*0.4 0.5*
	4387.8	0	0	0	1	1	1	?	2 g	. . . .	. . . .	0.9 0.9	. .	. . . .	. . . .	0.2 *0.2*	*0.2* 0.2	. . . .
	4389.8	0	0	0	0	0	1	4	2 g	. . . .	. . . .	. . . .	. .	. . . .	. . . .	. . . .	. . 0.5	0.0 0.0
	4391.2	1	1	1	1	2			3	0.1 *0.6*	*0.6* 0.1	0.0 0.3	0.2	*0.1* 0.3	. . *0.5*	0.4 0.0	. . . .	
	4392.0	0	0	0	0		1	1	2 g	. . . .	. . . .	. . . .	. .	. . . .	*0.3* . .	. . . .	0.3 *0.5*	. . . .
	4394.3	0	0	0	0	0	1	0	2	. . . .	. . . .	. . . .	. .	. . . .	. . . .	. . . .	. . 0.3	*0.9* . .
	4395.3	1	2	3	3	3	3	4	3 d	*0.3* 0.2	0.2 0.1	0.4 0.3	*0.1*	0.0 0.3	0.5 *0.1*	0.4 0.4	0.4 0.6	0.3 0.3
	4398.2	0	0	0	?	0	1	1	2	. . . .	. . . .	*0.1* 0.0	. .	. . . .	0.5 *0.7*	. . . .	. . 0.2	*0.1* 0.0
	4400.2	0	1	1	2	0	0	0	3 d	. . . .	*0.1* 0.0	0.4 0.1	0.3	0.5 0.2	. . 0.1	. . . .	. . . .	. . . .
	4401.6	0	0		3	3	3	4	3	1.3 *1.3*	. . . .		. .	. . . .	*0.6* . .	*0.3 0.6*	*0.5 0.3*	0.0 *0.6*
	4405.0	0	1	1	2	4	6	7	5	0.1 0.0	*0.3* 0.2	0.0 *0.1*	0.1	0.0 0.3	0.3 *0.6*	0.1 0.0	*0.1* 0.3	0.6 0.4
	4408.5	0	0	0	2	2	4	7	3	. . . .	. . . .	0.1 0.0	. .	. . 0.4	0.9 0.0	0.4 0.3	0.3 0.5	0.4 0.0
	4412.1	0	0	0	1	1	1	1	2	. . . .	. . . .	*0.1 0.7*	*1.5*	*0.5 0.1*	0.3 *1.1*	0.0 0.0	0.1 0.5	0.8 0.1
	4415.3	1	1	1	2	3	4	4	4	. . . .	. . . .	0.0 0.2	. .	0.3 0.3	0.3 *0.3*	0.1 0.2	0.2 0.5	0.3 0.3
	4417.9	0	1	2	2	2	1	2	2	0.2 *0.4*	*0.5 0.5*	0.5 0.1	*0.2*	0.3 *0.4*	0.5 *0.1*	0.2 0.5	*0.3 0.3*	0.5 0.3
	4420.5	0	0	0	0	0	?	1	1	. . . .	. . . .	. . . .	. .	. . . .	. . . .	. . . .	. . 0.0	*0.3* . .
	4422.8	0	0	1	2	3	3	3	2	1.4 . .	. . . .	0.2 0.1	*0.1*	*0.2 0.1*	*0.2* 0.2	0.4 0.2	0.0 0.1	*1.0 0.5*
	4424.2	0	0	0	0	0	?	1	1	. . . .	. . . .	. . . .	. .	. . . .	. . . .	. . . .	. . 0.5	*1.1* 0.0
	4425.6	0	0	0	1	1	2	2	2	. . . .	. . . .	0.4 *0.1*	. .	. . . .	. . . .	*0.3* 0.1	0.4 0.6	0.4 0.1
	4427.4	0	0	0	2	1	2	4	3 d	. . . .	. . . .	0.2 0.2	. .	0.5 0.0	0.4 0.4	0.0 0.4	0.3 0.5	0.3 0.4
	4430.8	0	0	0	2	2	4	3	2	. . . .	. . . .	0.1 *0.2*	. .	*0.1* 0.1	*0.3 0.2*	*0.2* 0.2	*0.4* 0.1	0.2 *0.3*
	4433.5	0	0	?	0	0	1	?	2	. . . .	. . . .	. . . .	. .	. . . .	. . . .	. . . .	0.7 0.4	0.3 0.3
	4435.2	0	0	0	2	3	5	8	3 d	. . . .	. . . .	0.3 0.5	. .	0.2 0.4	0.4 0.3	0.5 0.4	0.3 0.8	0.8 0.6
	4438.5	0	0	0	0	0	1	1	1	. . . .	. . . .	. . . .	. .	. . . .	. . . .	. . . .	*0.1 0.2*	0.2 0.1
	4441.0	0	0	0	0	0	1	0	1 g	. . . .	. . . .	*1.4* . .	. .	. . . .	. . . .	. . . .	*0.3* . .	. . . .
	4442.5	0	0	0	?	1	2	3	3	. . . .	. . . .	. . . .	. .	. . . .	. . . .	. . . .	0.3 . .	0.2 0.3
	4444.0	1	1	2	2	2	2	3	3	0.0 0.1	0.8 0.1	*0.3 0.2*	0.3	*0.5 0.3*	0.0 *0.2*	*0.6 0.2*	0.5 *0.6*	*0.4* 0.1
	4445.7	0	0	0	0	0	0	1	1	. . . .	. . . .	. . . .	. .	. . . .	. . . .	. . . .	. . . .	0.5 0.2
	4447.9	0	0	0	1	1	2	2	3	. . . .	. . . .	0.1 0.0	. .	. . . .	. . . .	*0.5 0.3*	*0.1* 0.0	*0.3 0.2*
	4450.6	0	0	1	2	2	2	2	2 d	0.4 0.8	0.7 0.9	0.7 0.4	0.4	0.5 0.7	0.1 0.3	0.0 0.2	0.1 0.1	0.6 *0.1*
	4453.5	0	0	0	0	0	1	1	2	. . . .	. . . .	. . . .	. .	. . . .	. . . .	. . . .	*0.2 0.2*	*0.3 0.2*

Desig.	Wave Length.	VI.	VII.	VIII.	XII.	XIV.	XV.	XVIII.	S. S.	470	484	1486	1507	387	493	1086	458	1717	506	694	383	420	401	475	1493	1504
	4455.0	0	0	1	3	8	2	8	4 g	2.1	0.7	..	..	0.6	1.1	*0.1*	0.2	0.6	*0.1*	0.8	0.3	0.3	0.8	0.5	0.7	0.6
	4457.6	0	0	0	0	0	0	?	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*0.3*	..
	4459.3	0	0	0	2	2	2	2	3	..	..	..	..	*0.1*	0.4	..	..	..	..	..	0.2	0.1	0.8	0.7	0.8	0.5
	4462.0	0	0	0	2	3	4	5	3 d	..	..	..	..	0.3	0.0	0.0	0.0	*0.7*	0.2	*0.1*	0.0	0.3	0.3	0.7	0.3	0.3
	4464.8	0	0	0	1	1	1	1	3 d	..	..	..	..	..	0.0	0.1	*0.1*	*0.1*	0.2	*0.5*	0.0	0.5	0.3	0.7	..	..
	4466.8	0	0	0	1	1	1	3	3	..	..	..	..	*0.2*	*0.2*	..	..	..	..	..	0.2	*0.1*	0.1	0.4	0.1	0.0
	4469.5	?	1	1	2	2	2	2	2	*0.1*	*0.5*	*0.5*	*0.3*	0.0	0.3	*0.7*	*0.5*	*0.6*	*0.3*	0.0	0.3	0.5	*0.1*	0.4	*0.4*	*0.5*
	4471.0	0	0	0	2	1	1	0	2	..	..	..	..	*0.3*	..	..	0.1	..	0.3	*0.1*	..	..	0.5	0.8	..	..
	4473.0	0	0	0	1	0	1	3	2 d	..	..	..	..	0.1	0.1	..	0.0	0.8	0.6	0.1	*0.6*	..	0.0	0.4	*0.6*	*1.0*
	4475.0	0	0	0	0	0	1	2	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0.6	..	..
	4476.2	0	0	0	1	1	2		3	..	..	..	..	*0.2*	0.2	..	0.2	0.2	0.4	1.0	0.2	0.3	*0.4*	0.4	0.1	*0.3*
	4480.0	0	0	0	0	?	3	1	2 g	..	..	..	..	..	..	..	..	..	..	..	..	..	0.7	0.5	0.3	..
	4481.4	4	4	5	5	4	0	0	2 d	0.7	0.4	0.3	0.4	..	..	0.3	0.3	..	0.3	..	..	..	..	..	..	..
	4482.5	0	0	0			3	5	4	..	..	..	..	*0.6*	*0.4*	..	..	0.1			*0.4*	*0.8*	0.0	0.4	0.0	*0.1*
	4484.4	0	0	0	0	?	1	1	2	..	..	..	..	..	..	..	..	..	..	..	..	..	0.0	0.7	0.2	*0.1*
	4485.9	0	0	0	?	0	?		2	..	..	..	..	0.1	0.2	..	..	..	..	..	..	..	..	..	..	*0.1*
	4488.4	0	0	0	0	0	0	?	2 d	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*0.9*
	4490.0	0	1	1	2	4	4	5	2 d	..	*0.7*	*0.6*	*0.5*	*0.1*	*0.8*	*0.6*	*0.6*	*0.5*	*0.5*	0.4	0.1	0.2	0.1	0.4	0.4	0.4
	4491.6	0	0	1	2	0	0	0	2	*0.7*	0.2	0.5	0.2	..	0.3	0.2	0.3	*0.2*	0.0	..	..	..	..	..	..	..
	4494.8	0	0	0	1	2	3	2	3	..	..	..	..	0.1	0.0	0.0	*0.4*	0.0	0.1	0.6	0.1	1.0	0.3	0.2	0.0	0.1
	4497.0	0	0	0	1	1	3	4	2	..	..	..	..	*0.7*	*0.2*	..	0.2	0.2	0.2	0.6	0.1	..	*0.3*	0.2	*0.1*	*0.1*
	4499.1	0	0	0	1	0	1	1	2 d	..	..	..	..	*0.6*	0.0	..	..	..	..	..	..	..	0.2	*0.2*	..	0.4
	4501.5	0	1	2	3	8	3	3	3	*0.1*	0.0	0.1	0.0	*0.2*	*0.3*	*0.2*	*0.6*	0.0	*0.3*	0.4	*0.3*	0.1	*0.1*	0.5	0.5	0.3
	4507.0	0	0	0	0	0	1	2	0	..	..	..	..	..	..	..	..	..	..	..	..	..	*1.3*	..	*0.2*	0.8
	4508.5	1	1	2	2	2	?	0	3	*0.1*	*1.2*	0.3	0.4	*0.1*	0.0	0.3	0.2	0.3	0.3	0.9	0.6	*0.4*	1.8	*0.3*	..	..
	4513.0	0	0	0	0	1	1	2	2	..	..	..	..	..	..	..	..	..	..	..	..	*0.2*	*0.7*	1.2	..	0.7
	4515.4	0	1	2	2	2	1	0	2	0.9	0.3	0.4	0.5	*0.1*	*0.2*	0.2	0.2	0.2	0.3	1.1	0.0	0.1	..	..	*0.9*	..
	4518.0	0	0	0	1	1	2	3	2 g	..	..	..	..	0.9	0.6	..	..	..	..	..	0.3	0.3	0.4	1.0	0.4	..
	4520.3	0	1	1	1	1	1	1	2 d	0.4	0.6	0.6	0.8	..	0.5	0.4	*0.4*	0.3	0.4	0.4	0.4	0.0	*0.1*	0.6	*0.4*	..
	4522.9	1	1	1	2	2	2	2	3 d	0.8	0.1	2.4	..	0.1	0.1	0.0	0.4	*0.2*	0.7	0.5	*0.1*	0.0	0.1	0.6	1.4	0.4
	4525.3	0	0	0	1	0	?	0	3	..	..	..	..	*0.3*	*0.3*	..	..	*0.2*	..	..	*1.1*	*1.1*	..	0.3	..	..
	4527.0	0	0	0	1	1	1	3	3 g	..	..	..	..	*0.3*	*0.1*	..	..	..	..	..	..	*0.4*	0.2	0.4	..	0.5
	4528.8	0	0	0	1	1	2	3	4	..	..	..	..	*0.1*	0.3	0.5	0.7	0.4	0.3	*0.9*	..	*0.1*	0.1	0.5	*0.2*	*0.2*
	4531.2	0	1	0	1	1	2	3	3 g	..	..	..	..	*0.5*	0.1	..	..	0.3	0.3	*0.9*	0.5	*0.1*	0.2	0.2	0.2	*0.2*
	4534.2	1	1	2	2	?	1	?	3 d	0.2	0.5	0.0	0.4	0.8	0.1	*0.1*	0.7	0.7	0.3	..	..	..	..	*0.3*	..	..
	4535.0	0	0	0	0	0	0	7	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0.1	0.2
	4536.0	0	0	0	2	3	4		3 g	..	..	..	..	..	0.2	..	..	..	..	*0.6*	*0.5*	*0.6*	*0.2*	0.3		
	4541.6	0	1	1	1	2	2	3	2	*0.4*	0.1	0.3	0.5	*0.8*	0.1	0.6	*0.8*	0.5	*0.3*	1.1	*0.2*	*0.4*	*0.4*	*0.7*	*0.4*	0.0
	4544.9	0	0	0	1	?	2	3	3	..	..	..	..	0.4	0.1	0.4	0.4	0.3	0.7	..	0.2	0.8	0.6	0.1	1.3	0.6
	4547.2	0	0	0	0	2	0	0	2 d	..	..	..	..	..	*0.2*	..	..	..	..	*0.8*	..	..	..	0.5	..	..
	4549.7	2	2	3	4	3	3	4	4 d	0.1	0.3	*0.1*	0.4	0.1	0.0	0.1	0.4	0.4	0.1	2.0	0.1	0.1	*0.1*	0.2	0.4	*0.1*
	4552.7	0	0	0	0	0	1	1	4	..	..	..	..	..	*0.8*	..	..	..	..	..	*0.3*	..	0.0	0.1	..	*0.5*
	4554.2	0	?	1	1	1	1	3	4	*0.3*	..	..	..	0.6	0.1	..	..	..	..	..	..	*0.3*	0.2	0.6	0.0	0.1
	4556.0	1	1	2	2	2	2	2	3 g	..	*0.5*	*0.1*	0.1	..	0.1	*0.3*	*0.5*	*0.7*	*0.3*	0.8	*0.3*	*0.4*	0.4	*0.1*	*0.3*	*0.3*
	4558.9	0	1	1	1	1	1	1	2	0.1	0.3	*0.2*	0.1	0.4	*0.6*	0.3	0.9	0.8	0.4	..	*0.6*	0.8	..	*0.5*	..	..
	4561.0	0	0	0	1	1	1	2	1 d	..	..	..	..	..	*0.3*	..	..	..	..	0.8	*0.3*	..	*0.1*	*0.4*	*0.6*	*0.3*
	4564.0	1	1	2	2	4	1	3	3	0.3	0.2	0.4	0.4	0.5	*0.2*	*0.2*	0.4	0.8	*0.2*	..	..	..	0.2	*0.1*	*0.3*	*0.2*
	4565.8	0	0	?	1		3	2	3 d	..	..	..	..	2.5	0.7	..	..	..	..	0.8	*0.1*	*1.0*	*0.7*	0.3	0.0	*0.3*
	4569.0	0	0	0	0	1	1	0	2	..	..	..	..	..	..	..	..	..	.	..	*0.1*	..	*0.5*	0.2	..	..

Desig.	Wave Length.	VI.	VII.	VIII.	XII.	XIV.	XV.	XVIII.	S. S.	470	484	1486	1507	387	498	1066	453	1717	505	634	368	429	401	475	1498	1504
	4572.2	1	1	2	3	3	4	4	3	0.1	0.2	0.4	0.2	*0.3*	0.0	0.1	0.3	0.2	0.1	. .	*0.2*	*0.3*	*0.2*	0.0	0.1	*0.2*
	4574.7	0	0	0	0	1	1	1	2 d	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	*0.3*	*0.1*	. .	1.2	0.2	0.7	1.0
	4576.5	0	0	1	1	1	?	1	2	0.5	0.2	0.1	0.1	0.3	0.2	*0.1*	0.2	. .	*0.2*	1.4	0.7	*0.3*	. .	0.3	0.7	0.8
	4578.7	0	0	0	0	0	0	1	2	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	4580.2	0	0	0	?	2	2	3	2	. .	. .	. .	. .	*0.6*	. .	. .	. .	. .	. .	. .	*0.2*	0.2	0.4	0.7	0.4	0.2
	4581.7	0	0	0	1		1	0	4	. .	. .	. .	. .	. .	*0.4*	. .	. .	. .	. .	. .	0.5	1.3	. .	. .	. .	. .
	4584.0	1	1	2	2	2	1	2	2	*0.1*	*0.1*	*0.1*	0.2	*0.5*	*0.1*	*0.2*	*0.1*	0.0	*0.1*	. .	*0.1*	. .	*0.2*	0.1	0.9	0.0
	4586.1	0	0	0	1	1	2	2	3	. .	. .	. .	. .	. .	0.3	. .	. .	. .	. .	*0.1*	*0.1*	*0.6*	0.5	0.4	0.7	0.0
	4588.4	0	1	1	1	0	0	0	2	*0.6*	0.7	. .	. .	1.0	*0.1*	. .	. .	. .	. .	. .	. .	*0.8*	. .	. .	. .	. .
	4590.1	0	0	0	1	0	0	0	2	. .	. .	. .	. .	. .	0.1	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	4592.8	0	0	?	2	2	1	2	4 d	*0.7*	0.2	. .	. .	*0.5*	0.0	. .	*0.6*	1.1	0.2	. .	*0.2*	*0.7*	*0.5*	*0.6*	*0.7*	*0.9*
	4595.9	0	0	0	1	1	1	3	2 g	. .	. .	. .	. .	*0.4*	0.0	. .	. .	. .	. .	0.3	*0.2*	0.6	*0.7*	0.0	*1.2*	*1.2*
	4598.2	0	0	0	1	1	1	1	2 g	. .	. .	. .	. .	*0.7*	0.2	. .	. .	. .	. .	. .	*0.3*	. .	*0.4*	0.1	*0.1*	0.1
	4600.6	0	0	0	1	2	2	2	3 g	. .	. .	. .	. .	0.1	0.5	. .	. .	. .	. .	. .	0.2	0.7	0.2	0.1	*0.2*	0.2
	4603.1	0	0	0	0	?	1	1	3	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	0.0	. .	*0.8*	0.1	*1.1*	*0.1*
	4605.5	0	0	0	1	1	1	0	2	. .	. .	. .	. .	. .	0.2	. .	. .	. .	. .	. .	0.3	0.5	. .	*0.4*	. .	. .
	4606.4	0	0	0	0	0	?	3	2	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	*0.3*	0.0
	4607.9	0	0	0	1	1	1		2	. .	. .	. .	. .	*0.4*	*0.5*	. .	. .	. .	. .	. .	0.3	. .	0.0	*0.3*		
	4611.4	0	0	0	1	1	1	1	4	. .	. .	. .	. .	*0.2*	*0.2*	. .	. .	. .	. .	. .	*0.2*	0.0	*0.3*	*0.4*	0.5	0.2
	4613.5	0	0	0	1	1	1	2	3 d	. .	. .	. .	. .	0.0	0.1	. .	. .	. .	0.4	*1.0*	0.2	0.0	0.2	. .	0.5	*0.1*
	4616.9	0	0	0	1	1	1	2	3 g	*0.3*	. .	. .	. .	*0.1*	*0.7*	. .	0.3	*0.3*	0.0	0.3	*0.6*	*0.2*	0.0	*0.3*	*1.0*	0.0
	4619.2	0	1	1	1	2	2	2	3 g	. .	. .	0.9	0.4	*0.1*	0.8	0.5	1.1	1.0	1.0	1.4	0.4	0.0	0.5	0.7	0.9	1.0
	4622.8	0	0	0	0	1	1	1	2 g	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	*0.4*	0.2	0.0	0.8	1.6	0.1
	4625.8	0	0	0	1	1	1	2	3 d	. .	. .	. .	. .	0.7	*0.1*	. .	0.3	. .	0.1	*0.7*	0.6	0.8	0.6	1.1	0.5	0.6
	4629.9	0	1	1	2	2	2	3	3 d	*0.9*	0.1	*0.4*	0.0	0.1	*0.2*	*0.3*	*0.2*	0.2	0.1	. .	*0.5*	*0.1*	*0.1*	0.1	0.4	0.2
	4633.0	0	0	0	1	2	1	1	3	. .	. .	. .	. .	0.5	0.7	. .	. .	. .	1.2	. .	0.5	0.8	0.3	0.4	. .	. .
	4635.3	0	1	1	?	0	1	1	0	*1.1*	*0.4*	. .	. .	1.3	0.5	. .	. .	. .	. .	. .	0.1	. .	*0.2*	0.0	*0.5*	*1.0*
	4638.0	0	0	0	1	1	1	1	3	. .	. .	. .	. .	1.0	0.2	. .	. .	. .	. .	. .	*0.3*	*0.9*	*0.7*	*0.3*	0.0	*0.5*
	4640.0	0	0	0	0	1	3	3	2 g	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	0.4	*0.3*	0.1	0.4	0.4	0.0
	4643.7	0	0	0	0	?	1	1	2	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	0.1	. .	0.1	*0.1*	*0.1*	*0.2*
	4647.6	0	0	0	3	4	4	4	2	. .	. .	. .	. .	0.1	*0.2*	. .	0.1	0.4	. .	. .	*2.0*	0.1	*0.1*	*0.5*	*0.3*	*0.6*
	4652.0	0	0	0	1	?	1	2	3 d	. .	. .	. .	. .	. .	*0.2*	. .	. .	. .	. .	. .	*1.5*	. .	0.3	0.0	0.0	0.1
	4654.8	0	0	0	1	1	1	1	4	. .	. .	. .	. .	*0.7*	*0.1*	. .	. .	. .	. .	*1.6*	*1.3*	. .	*0.2*	*0.1*	*0.8*	*0.8*
	4657.0	0	0	0	1	2	3	4	2 g	. .	. .	. .	*0.5*	0.5	0.2	0.1	0.3	0.5	0.5	. .	1.9	*0.7*	*0.6*	0.0	*0.1*	*0.4*
	4663.7	0	0	0	1	2	2	2	2 g	. .	. .	. .	. .	. .	*0.7*	0.3	0.2	0.1	*0.1*	*2.0*	*0.7*	*0.7*	*0.3*	*0.3*	*0.1*	*0.2*
	4668.0	0	0	1	4	5	5	5	4 g	*1.0*	. .	. .	. .	*0.3*	0.1	*1.2*	*0.3*	*0.3*	*0.4*	0.5	0.2	*0.5*	*0.1*	0.1	0.8	0.5
	4670.5	0	0	0	0	0	0	0	2 d	. .	. .	. .	. .	. .	. .	*0.5*	0.1	*0.4*	*0.5*	. .	. .	. .	. .	. .	. .	. .
	4673.3	0	0	0	1	2	0	1	3	. .	. .	. .	. .	0.8	*0.1*	. .	. .	. .	. .	. .	0.7	0.8	. .	. .	*1.5*	. .
	4674.8	0	0	0	0	?	2	2	2 g	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	*0.5*	. .	. .	0.0	0.4	0.2	0.4
	4679.0	0	0	0	1	2	0	0	3	. .	. .	. .	. .	0.2	*0.4*	. .	0.9	. .	*1.0*	. .	*0.8*	. .	. .	. .	*1.6*	. .
	4680.6	0	0	0	0	?	1	?	3 g	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	*0.5*	. .	. .	. .	. .
	4682.2	0	0	0	1	2	2	3	3 g	. .	. .	. .	. .	0.3	. .	. .	*0.3*	*0.7*	. .	. .	0.1	. .	*0.3*	*0.6*	0.2	*0.4*
	4688.0	0	0	0	0	?	1	2	2 d	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	0.4	*0.7*	0.1	*0.1*
	4691.6	0	0	0	1	?	1	1	3 d	. .	. .	. .	. .	0.4	*0.3*	. .	1.1	0.5	0.9	. .	. .	. .	*0.2*	*0.3*	. .	*0.3*
	4694.0	0	0	0	0	1	1	1	1 g	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	0.4	0.9	*0.1*	0.7	*0.9*	0.4
	4698.8	0	0	0	1	3	3	3	3 g	. .	. .	. .	. .	0.5	*0.1*	. .	0.5	0.4	0.5	*1.0*	*0.2*	0.0	*0.2*	0.1	1.2	0.6
	4703.1	0	?	1	3	3	2	2	4	0.0	. .	. .	. .	0.6	0.1	. .	*0.1*	0.4	1.1	2.5	0.3	*0.1*	0.5	0.2	0.7	0.7
	4707.5	0	0	0	0	0	?	2	3 d	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	4709.0	0	0	0	3	3	0	0	2 g	. .	. .	. .	. .	*0.4*	*0.3*	0.1	0.0	0.1	0.0	0.9	0.6	0.0	0.3	0.3	. .	. .

Desig.	Wave Length.	VI.	VII.	VIII.	XII.	XIV.	XV.	XVIII.	S. S.	470 484	1486 1507	387 493	1086	453 1717	505 634	388 429	401 475	1493 1504
	4710.2	0	0	0	0	0	2	3	2 d	....	....	....	..	....	....	....	....	*0.4 0.9*
	4714.5	0	?	0	2	3	3	3	3	....	....	0.6 0.2	..	0.6 1.3	1.4 1.7	0.7 0.1	0.4 0.5	0.7 1.2
	4718.6	0	0	0	1	1	0	?	2	....	....	0.3 0.0	..	....	....	*0.6 0.1*	....	1.1 0.4
	4722.3	0	0	0	1	1	2	2	2	....	....	0.3 0.9	..	....	....	0.6 0.8	1.5 1.0	1.1 1.4
	4727.6	0	0	0	2	3	3	3	3	....	....	*0.2* ..	..	1.4 ..	.. *0.7*	*0.6 0.7*	0.6 ..	1.7 1.2
	4731.7	0	1	0	2	1	1	2	3	....	0.0 0.1	.. 0.4	*0.2*	0.3 0.1	*0.3 1.4*	1.6 0.6	*0.6* ..	*0.2 0.1*
	4733.8	0	0	0	0	0	1	2	3	....	....	....	..	....	....	....	0.1 0.4	0.0 0.1
	4737.0	0	0	0	2	2	2	2	3	....	....	0.0 *0.2*	..	0.7 0.1	0.3 1.0	0.1 0.0	0.4 0.2	*0.9* 0.5
	4741.1	0	0	0	1	1	2	0	2 d	....	....	0.4 0.5	..	....	....	0.6 0.2	0.5 0.6	....
	4743.0	0	0	0	0	0	?	2	1	....	....	....	..	....	....	....	....	*0.7 1.2*
	4746.0	0	0	0	1	?	1	1	3	....	....	0.0 *0.4*	..	....	....	*0.1 0.6*	*0.7 0.2*	*0.6 0.3*
	4748.4	0	0	0	0	?	0	0	3	....	....	....	..	....	....	0.2 ..	....	....
	4750.0	0	0	0	0	0	0	1	2 g	....	....	....	1.3	....	....	.. 0.7	....	0.0 *0.7*
	4754.2	0	0	0	1	1	1	2	3	....	....	*1.1 0.1*	..	0.2 ..	....	....	0.2 *0.3*	0.8 *0.2*
	4756.4	0	0	0	1	1	1	?	3 d	....	....	0.1 0.5	0.6	....	*0.8* ..	....	.. *0.1*	....
	4758.7	0	0	0	0	0	1	2	2 g	....	....	....	..	....	....	1.0 *0.1*	0.3 ..	0.3 0.5
	4762.6	0	0	0	2	2	2	3	3	....	....	1.1 0.8	..	....	.. 0.2	*0.9* ..	0.1 ..	0.5 ..
	4764.1	0	0	0	0	0	?	0	3	....	....	....	*0.7*	0.5 0.1	*0.3* ..	....	.. 0.5	....
	4766.1	0	0	0	2	2	2	4	3	....	....	.. 0.6	..	....	....	*1.0* ..	0.2 ..	0.3 *0.5*
	4768.5	0	0	0	0	0	0	1	3	....	....	*0.4* ..	..	....	....	.. *0.5*	.. *0.1*	1.3 ..
	4771.8	0	0	0	2	2	3	4	3 d	....	....	0.3 ..	..	0.0 0.7	0.3 *0.1*	*0.1* 0.7	0.0 0.0	....
	4773.0	0	0	0	0	0			3	....	....	.. *0.3*	..	....	....	....		0.6 0.1
	4776.5	0	0	0	0	1	0	0	2 g	....	....	....	..	....	....	0.1 ..	0.5 *0.3*	1.1 0.5
	4780.1	0	0	0	1	0	0	1	2	....	....	.. *0.3*	..	....	*0.1* 0.8	....	0.4 1.0	....
	4783.6	0	0	0	1	?	1	2	4	....	....	*0.9* 0.3	..	....	....	*0.5 0.8*	*0.4* 0.1	0.5 0.6
	4786.8	0	0	0	1	1	1	1	3 d	....	....	.. 1.0	..	*1.0* ..	*0.2* 0.2	*0.4* 0.1	*0.6 0.2*	....
	4789.7	0	0	0	1	1	1	1	3 d	....	....	1.5 0.4	..	....	....	0.1 *0.6*	0.3 *0.3*	....
	4792.7	0	0	0	0	1	1	1	2 g	....	....	....	..	....	....	*0.2 0.4*	0.1 0.1	*0.1* 0.8
	4799.9	0	0	0	1	2	3	3	2	....	....	*0.9 0.6*	..	0.2 *0.6*	*0.1* ..	*0.5* 0.1	*0.3 0.3*	0.0 *0.2*
	4805.2	0	0	0	1	1	0	2	3	....	....	0.0 ..	*0.2*	0.7 0.4	1.1 ..	0.0 0.9	....	0.3 ..
	4808.0	0	0	0	0	1	2	2	2 g	....	....	....	..	....	.. *0.6*	0.8 0.6	0.6 *0.9*	.. *1.1*
	4813.0	0	0	0	0	0	0	2	1 g	....	....	....	..	....	....	....	0.8 1.3	*0.8 1.0*
	4818.0	0	0	0	0	0	1	2	2	....	....	....	*2.0*	....	....	....	....	0.3 *1.3*
	4821.0	0	0	0	0	0	0	1	2 d	....	....	....	..	....	.. 0.9	....	*0.8 0.8*	*0.4* 0.5
	4824.0	0	1	1	4	4	3	3	3 d	.. *2.9*	....	*0.2* 0.7	0.6	*0.3* 0.5	0.6 ..	0.2 0.1	0.3 0.0	0.6 0.5
	4829.3	0	0	0	0	1	1	3	3 d	....	....	....	..	....	....	.. *0.1*	*0.4* 0.1	*0.2 0.4*
	4832.9	0	0	0	0	1	2	4	2	....	....	....	..	....	....	*0.1 0.4*	*1.1 0.8*	0.5 *0.3*
	4836.0	0	0	0	0	1	?	1	2	....	....	....	0.9	1.4 0.2	....	0.2 1.7	*0.2* 0.0	0.9 0.8
	4839.9	0	0	0	0	1	2	2	3 d	....	....	....	..	....	....	1.3 0.0	1.0 *0.4*	0.9 0.6
	4843.2	0	0	0	0	1	2	2	2 d	....	....	....	..	....	....	0.9 0.4	0.8 *0.1*	0.5 *0.4*
	4848.4	0	0	0	1	2	2	2	2	....	....	*1.9* 1.4	0.5	*0.1* 0.8	1.0 ..	1.3 0.3	0.8 *0.4*	0.7 0.8
	4852.3	0	0	0	0	0	?	2	2 d	....	....	....	..	....	....	....	0.3 *0.4*	*0.4 0.2*
	4855.7	0	0	0	0	3	3	2	3 d	....	....	....	*0.1*	*0.5* 0.5	....	0.5 0.1	*0.1* 0.3	0.7 0.6
H β	4861.5	65	65	60	16	10	6	4	5	.. *0.1*	....	*0.3* 0.6	*0.5*	*0.5* 0.9	0.4 ..	0.4 *0.2*	*0.3 0.4*	0.4 0.4

REMARKS.

3735.0. Broad solar band omitted in table.

3749.4. Strong solar band omitted in table. Perhaps combined with Hκ.

3767.3. Strong solar line omitted in table.

3782.0. Diffuse band. Other stronger bands omitted in table.

3820.5. The line in β Persei of Group VI. is really the Orion line 3819.2, which may or may not combine with the solar line 3820.5.

3835.5. The intensity given for this line in α Canis Minoris is really that of a band which in the spectra of smaller dispersion appears to extend from wave length 3832.5 to 3840.8.

3854.6, 3856.5, 3863.9. In β Persei of Group VI., the lines present are the Orion lines 3854.2, 3856.2, and 3863.2.

3890.5. Many stronger solar lines near.

3933.8. The intensity given for this line in Group XVIII. is the average of the estimated intensities in a number of stars of the group.

3968.6. The intensity given for this line in Group XVIII. is the average of the estimated intensities in a number of stars of the group. This line as seen in stars of Group XV. forms a band fading at the edges and extending from 3963.4 to 3974.7.

4015.2. This line does not appear in the solar spectrum.

4069.4. Stronger solar lines near which are omitted in table.

4101.8. The estimated intensity of this and the remaining lines of hydrogen given in Group XVIII. is the average intensity estimated in a number of stars in the group. The intensity of these lines in α Orionis, estimated as 8, is considerably higher than in the other stars of the group.

4128.5. This is an Orion line.

4131.4. This is an Orion line.

4140.3. This is the centre of a double line, 4140.1, 4140.5, in the solar spectrum. In α Orionis 4140.1 alone is present.

4143.9. This band in the solar spectrum includes 4143.7 and 4144.0. The Orion line 4144.0 appears to fall within this band, and is present at least in Group VI. See remark on this line on p. 126.

4160.2. The principal line as seen on Rowland's map is at 4160.6, but faint accompanying lines extend to 4159.8. As the line in α Boötis appears somewhat wide and hazy, and as the micrometric measures indicate a shorter wave length than 4160.6, it is probable that the band in α Boötis includes all these lines.

4165.6. This band as seen in α Orionis probably extends to 4164.5 so that the centre would have the wave length 4165.0.

4227.0. The intensity given for Group XVIII. is the average of the estimated intensities in a number of stars in the group. The intensity in α Orionis is estimated as 15, but this is much less than in the other stars.

4233.6. This band in α Orionis is more extensive than in the Sun.

4247.3. This line is seen in photographs of α Lyræ, and not in those of α Canis Majoris.

4253.0. The lines in this group are very faint.

4289.9. This band as seen in the Sun is wide and complex. The strongest line in it is at wave length 4289.9.

4340.7. See remark on 4101.8.

4356.8. Stronger solar lines near which are omitted in table.

4387.8. Other stronger lines near in solar spectrum.

4507.0. This line is extremely faint in the solar spectrum.

4635.3. Only faint lines present in this part of the solar spectrum.

4758.7. The group in the solar spectrum includes 4758.0 and 4759.5. It was not possible to decide whether one only, or both, of these were present in α Boötis and α Orionis.

4861.5. See remark on 4101.8.

The average value of the residuals in Table V. is ± 0.03.

As regards the degree of accuracy with which the wave lengths can be obtained by the method of identification here used, and described in the Introduction, it is to be said that, since the majority of lines seen in photographs of the Sun and stars of the second type taken with the same number of prisms correspond with double or multiple bands on Rowland's map, it is impossible to determine which components are present in any given star. All that can be done is to assume the centre of the band. Then, should it be resolvable in any of the stars, or should it appear narrower and be coincident with only a portion of the solar band, distinctions can be made. This, however, could only be done where the solar band had considerable width. The degree of accuracy with which the wave lengths can be obtained of course increases with the decreasing wave length.

It will be seen from this table that the solar lines as a whole steadily increase in number and intensity from Group VI. to Group XVIII. Although the groups between VIII. and XII. could not be here represented, it is perfectly clear from the plates of lower dispersion that the increase is uniform through these groups. The same applies to Groups XIII., XVI, and XVII., not represented in the table.

The degree of increase in intensity from Group VI. to Group XVIII. is in reality greater than appears from the estimated intensities, it being almost impossible to represent all the varying degrees of intensity shown in these lines.

Since the lines seen in the stellar photographs are evidently more or less complex, the question arises whether this apparent increase in their intensity is due to a real increase in the intensity of the constituent lines, or whether it results merely from increasing complexity. It is probably due to both causes.

From the general aspect of the spectral lines in the early first type stars, it can hardly be doubted that they are almost all single. This may be best seen in *α* Lyræ, the lines of which are very narrow and beautifully sharp and clear. In the following groups these lines grow wider, and more dense and complex in appearance, and in Group XIV. they may, from their close resemblance to the lines of the Sun, be fairly assumed to have nearly the same components. In the groups lying beyond the Sun in the series, especially in *α* Orionis, the lines become denser, wider, more hazy, and generally complex in appearance, and are frequently joined by haze, not uniform in intensity, and probably composed of multitudes of indistinguishable lines. The increasing complexity throughout the series may in that case be sufficient to account for the apparent increase of intensity.

On the other hand, it seems likely, from the law governing the hydrogen and Orion lines, and from the way the intensities of the solar lines vary throughout the groups, that, if the varying intensity of every line were known, from beginning to end of the series, each would be found to have a gradual development, a maximum intensity, and a gradual decline and disappearance.

In the case of the complex lines given in this table, it can be seen that, while a few maintain a uniform intensity and the majority show steady increase, a considerable number reach their maximum in one or other of the groups of the second type, and then decline, and sometimes disappear in the group following. The changing aspect of the lines would further indicate that their constituents are changing throughout the series.

As regards the lines that reach a maximum in Group XVIII., it is probable that most of them grow fainter in stars of Group XX., and perhaps in stars intermediate between Groups XIX. and XX.

It is unfortunate that these stars, owing to their red color, could not be photographed with a sufficient dispersion to be represented in this table. It is clear, however, from the plates taken with one prism, that, while some new lines may be developing or old ones increasing among the flutings and absorption bands, the majority of the lines of α Orionis, at least in regions not covered by the bands and flutings, are fainter and less numerous in these later stars of the third type.

CHAPTER V.

SOLAR LINES BETWEEN 4861 AND 5896.

TABLE VI. is supplementary to Table V. It contains the lines found between the wave lengths 4861 and 5896 in the stars of the second and third types, this region being photographed by means of plates stained with erythrosin.

The first column contains the wave lengths of the lines as obtained by identification with the solar lines on Rowland's map. The second column shows the roughly estimated intensities of these lines as seen in the comparison photograph of the Sun. The third column gives the intensities as seen in *α* Aurigæ, which belongs to the same group as the Sun. In the fourth column are the intensities of the same lines in *α* Boötis of Group XV., and in the fifth, their intensities in in *α* Orionis of Group XVIII.

The method of obtaining the wave lengths was to identify the lines of each star with a photograph of the solar spectrum taken on the same scale, and the lines of the latter with those of Rowland's map. The intensities are estimated on a scale nearly similar to that used in Table V., but the difference in the plates, owing to the use of erythrosin, may modify the estimates. Here, as in the preceding table, a zero indicates that a line was not seen; an interrogation point, that a doubtful trace was present; a dot, that the presence or absence of a line is undetermined, owing to faintness of the image in regions where absorption is strong. A number dropped below the line in the columns of intensity indicates that the spectral lines having the two wave lengths between which it stands are united in a band having the given intensity.

Lines entered in this table have been determined from plates taken with four prisms, but the intensities of a few lines in regions where the absorption is strong have been estimated from plates taken with three prisms.

It will be seen that there appears to be less increase in the intensity of the solar lines of this region in passing from the second to the third type than was shown in the lines of shorter wave length than 4861. The change is, however, greater than appears in the table, it not having been found possible to represent the slight differences in the intensities of the lines.

It will be noted that the lines have frequently greater intensity in the Sun than in *a* Aurigæ. This is, however, in most cases, due to the fact that in the solar spectrum taken with the slit spectroscope the lines are clearer than in *a* Aurigæ, a star whose lines are not sharply defined.

The lines of *a* Tauri of Group XVI., not entered in this table, agree nearly with those of *a* Boötis, except that a few referred to in the description of that group are stronger.

The lines of *a* Scorpii, which has a spectrum of the composite type, the primary spectrum being of Group XVII., include all found in *a* Orionis, and with few exceptions agree with the latter in intensity.

The sixth column of Table VI., like the tenth of Table V., gives the estimated intensity of the lines on the photographic map of Rowland. The presence of two or more lines is indicated by the letters d and g.

TABLE VI.

SOLAR LINES BETWEEN 4861 AND 5896.

Wave Length.	Sun.	α Aurigæ.	α Boötis	α Orionis.	S. S.	Wave Length.	Sun.	α Aurigæ.	α Boötis	α Orionis	S. S.	Wave Length.	Sun.	α Aurigæ.	α Boötis.	α Orionis.	S. S.
4861.5	11	11	4	6	5	4991.4	2	?	1	2	3 d	5153.5	1	1	2	2	2
4864.2	1	0	0	0	2 d	4994.3	1	?	1	2	3	5159.2	1	0	1	0	2
4865.4	0	3	3	2	0	4997.0	?	0	1	1	2 d	5162.5	1	0	1	0	2
4866.5	1	0	0	0	2	4999.8	1	?	1	3	3	5167.6	9	7	9	10	5
4868.0	1	0	1	1	2	5002.0	1		0	0	3	5172.9	10	8	10	5	5
4871.8	5	3	3	4	4 g	5006.1	3	3	2	3	4 d	5176.8	0	1	1	.	2
4876.0	1	1	1	3	2	5010.0	1	0	0	0	1 g	5183.8	13	11	13	3	5
4878.4	2	?	1	1	4	5012.3	2	0	4	4	3	5189.0	1	1	0	1	3
4882.1	1	0	2	5	2 g	5014.5	2	2			3	5192.2	3	2	2	3	3 d
4885.4	1	3	2	3	2 d	5018.6	2	2	0	0	4 d	5195.6	1	1	1	1	3 g
4886.9	1				2 g	5022.5	1	1	1	2	2	5202.5	1	0	0	?	3
4889.0	1	0	1	1	3 d	5027.4	2	1	1	.	3	5204.8	1	2	2	4	3
4891.3	5	4	3	4	4 d	5031.1	1	1	?	.	3	5206.2	1				3
4894.0	0	0	1	?	0	5036.1	3	1	2	3	3 g	5208.7	2	2	4	4	4 d
4896.6	1	0	0	?	1	5039.1	1	0	0	.	3 g	5216.8	2	2	1	1	3 g
4900.1	1	1	2	3	2 d	5041.6	5	5	5	7	4 g	5227.1	5	5	5	6	4 g
4904.0	2	1	2	3	3 d	5048.5	1	1	2	3	2 g	5230.0	1	0	0	0	2
4910.5	2	2	3	3	3 g	5050.0	?				3	5233.1	2	2	2	2	3
4914.0	1	?	1	1	2 d	5051.8	1	1	2	2	3	5242.7	1	1	0	1	2
4919.1	2	4	4	7	3	5056.7	1	1	0	0	0	5247.5	1	1	2	3	2 d
4920.8	2				4	5060.2	1	0	1	2	2	5250.6	1	1	2	3	3 d
4924.6	1	2	1	4	3 d	5065.1	2	2	2	3	3 g	5255.1	1	1	2	3	2
4928.0	1	0	1	1	2	5069.0	1	1	1	1	3	5262.2	1	0	0	2	3 d
4930.5	1	0	1	0	2	5072.7	2	1	1	1	2 g	5264.0	0	1	1		3 d
4933.8	3	1	2	5	3 g	5075.8	1	?	1	1	3 d	5266.3	2	2	2	2	4 g
4939.5	3	3	3	6	3 g	5080.2	4	3	3	3	3 g	5270.2	5	4	5	5	5 d
4942.7	1	?	1	1	2	5083.9	1	1	1	?	3 d	5273.5	1	1	1	?	3 d
4946.6	2	?	1	1	3	5097.1	1	0	0	.	3	5275.7	2	2	2	1	3 g
4950.2	1	0	0	1	2	5098.8	3	3	3	2	3 d	5282.0	1	1	0	0	3
4953.1	1	0	0	0	2 d	5107.8	1	1	1	?	3 d	5283.8	2	2	3	3	3
4954.9	1	0	0	0	2 d	5110.2	1	1	1	3	3 d	5288.7	1	1	0	1	2
4957.6	7	3	4	12	5 d	5113.5	0	0	0	1	2 d	5294.0	1	1	0	1	1 g
4962.8	1	1	0	1	2	5115.6	1	1	0	0	3	5298.0	3	2	3	4	3 g
4966.2	1	1	3	3	3	5125.3	1	1	2	2	3	5302.5	1	2	2	3	3
4968.1	1	0			2	5127.6	0	0	1	2	2	5307.5	1	1	1	?	2
4970.4	1	1		?	2 g	5129.6	1	1	0	0	3 g	5316.9	1	1	0	?	3 d
4973.3	?	0	0	?	3	5131.8	0	0	1	1	2 d	5324.4	2	0	1	?	3
4978.8	1	1	1	?	3	5133.9	1	1	0	?	3	5328.5	6	4	5	5	4 g
4980.4	?	0	0	?	3	5137.4	1	1	1	2	3 d	5333.0	1	1	1	2	2 d
4983.1	3	4	3	4	3 g	5139.5	2		1		4 d	5340.6	3	2	2	2	4
4985.6	1		1	?	3 d	5142.9	1	1	1	2	3 g	5346.0	1	1	1	1	3
4989.2	1	0	?	0	2 d	5148.3	1	1	1	2	3 d	5349.1	1	1	1	2	3 g

Wave Length.	Sun.	α Aurigæ.	α Bootis.	α Orionis.	S. S.	Wave Length.	Sun.	α Aurigæ.	α Bootis	α Orionis.	S. S.	Wave Length.	Sun.	α Aurigæ.	α Bootis.	α Orionis	S. S.
5353.5	1	1	1	1	3	5510.1	1	0	0	0	2	5662.8	2	1	1	2	3
5363.0	1	1	1	1	3	5512.8	2	2	4	5	3 g	5667.7	1	1	1	2	2
5365.2	1	1	1	1	3 d	5528.6	4	3	3	2	4	5670.2	0	0	1	2	1 g
5370.0	4	4	4	6	3 d	5533.0	1	0	0	0	2	5675.7	1	0	0	0	2
5371.6					4	5535.3	2	2	1	2	3 d	5679.2	1	0	0	0	2
5377.8	0	0	0	1	2	5538.6	1	1	1	2	2	5682.8	2	2	2	2	3
5383.6	1	1	1	0	3	5543.8	2	1	1	0	3 d	5688.5	2	2	2	3	3
5393.3	1	1	1	1	3	5546.7	1	0	1	2	2	5695.1	1	0	0	0	2
5397.3	2	2	3	4	4	5555.0	2	1	1	1	3	5698.7	1	0	1	1	2 d
5400.7	1	1	1	1	3	5563.4	1	0	0	?	3 d	5701.9	1	1	1	2	3
5406.0	4	3	3	4	3	5565.9	1	0	0		2	5706.1	1	0	0	2	3
5410.0	2	2	2	4	3	5569.9	1	1	0	1	3	5709.8	2	3	3		4 d
5415.4	2	1	0	1	3	5573.0	2	1	1	1	3 d	5711.8	1			2	3 g
5420.6	1	1	1	1	2	5576.3	1	0	0	0	2	5718.0	?	0	0	1	3 d
5424.2	3	2	1	1	3	5582.1	1	0	0	0	2	5727.2	1	?	1	2	2 d
5429.9	3	2	2	2	4 d	5587.0	2	3	2	3	3	5732.0	1	1	1	1	3
5433.0	?	1	1	2	2 d	5589.6	1				3 g	5737.9	1	0	1	1	2
5434.8	2	2	2	2	3	5594.8	2	1	1	1	3	5742.0	1	0	1	1	2
5446.1	5	5	4	1	4 d	5598.6	2	1	0	3	3 d	5748.3	1	0	1	1	3 g
5455.8	5	4	3	5	4 d	5601.5	3	3	2		2	5753.6	3	3	3	1	4 g
5459.8	0	0	0	1	0	5603.0				1	4	5763.2	3	3	3	4	4
5463.3	4	3	1	1	3 d	5611.7	0	0	0	1	0	5773.8	1	1	1	1	3 d
5466.6	1	0	0	0	2	5615.8	5	4	3	2	4 d	5781.6	2	2	3	3	3 g
5470.8	1	0	1	0	1	5619.8	1	1	1	2	2 g	5785.0	2	2	3	3	3 g
5474.1	1	1	1	1	2	5624.8	3	2	2	2	3	5791.1	1	1	1	1	3
5476.8	5	4	3	3	3 g	5632.0	0	0	0	1	0	5798.2	1	1	1	1	3 d
5481.3	2	2	2	2	2 g	5634.1	1	0	1	0	2	5806.0	2	2	2	1	3 d
5483.4	1	1	1	?	2 d	5638.5	1	1		2	2	5816.6	2	2	2	2	3
5488.0	2	1	1	1	2	5641.6	1	1	1	1	3	5838.2	1	1	1	.	2
5490.6	1	?	1	2	1 d	5645.0	0	0	0	1	1 d	5853.0	1	1	1	.	3 d
5493.8	1	1	1	1	1	5650.5	1	1	0	?	2 g	5857.8	2	2	2	2	4 d
5497.8	2	2	2	2	3	5655.6	2	1	1	0	2 d	5890.0	7	6	7	6	5
5501.7	2	2	1	2	3	5658.5	3	2	3	3	3 g	5896.0	4	3	4	3	5
5507.0	2	2	2	2	3												

REMARKS.

4865.4. The line, as seen in the stars of this table, appears to be intermediate between the lines of the Sun 4864.2 and 4866.5. It has the appearance of a single, and not of a double line. As, however, these lines were a little defective in the solar plate, the line in the stars may agree with one or other of these lines, or possibly may cover both.

4894.0. This is the estimated position of the line in α Boötis and α Orionis, and agrees with that of a faint solar line on Rowland's map. The line in the stars probably includes also the stronger solar line 4893.0.

4957.6. This line as seen in α Orionis is wide, owing to combination with one of shorter wave length. This is probably the line 4956.2, which is faintly seen on Rowland's map.

5056.7. Only faint lines present in the solar spectrum near this position.

5098.8. The intensity given for this line in α Orionis is uncertain, owing to the faintness of the image.

5153.5. In α Boötis, in α Orionis, and less distinctly in the solar photographs, this line can be separated into two components having centres at 5151.5 and 5154.8. The first of these is double, the second quadruple, on Rowland's map. As seen in the photographs, they have about equal intensity.

5167.6, 5172.9, and 5183.8. The intensities given for these lines in α Orionis are uncertain, owing to the superposition of the absorption band, which has its edge of shorter wave length near 5167.6.

5216.8. This group appears to include the three lines 5215.4, 5216.5, and 5217.6.

5294.0. Only faint lines present in the solar spectrum near this position.

5316.9. This is the principal line in the solar corona.

5393.3. This appears to be the correct wave length, but owing to faintness of image and the crowding of lines in this region it is difficult to distinguish between this line and the lines 5391.7 and 5394.9.

5433.0. The line 5434.8 is probably combined with 5436.4, the three lines 5433.0, 5434.8, and 5436.4 merging into one dense band in the third type stars.

5459.8. The line on Rowland's map having this wave length is exceedingly faint. The line in α Orionis appears to agree with it in position. This line may, however, agree with some other faint solar line in this region.

5512.8. The intensities given to this line in α Orionis and α Boötis are large, owing to its combination with an adjacent line, probably 5514.7.

5611.7. Only faint lines present in the solar spectrum near this position.

5645.0. This appears to be the centre of a band containing lines 5644.8 and 5645.8.

5670.2. This is the centre of a faint triple band in the solar spectrum, extending from 5669.8 to 5671.0, to which the line in the stars probably corresponds. The faint line 5672.0 on the map may also belong to this band.

5718.0. The exact position of this line could not be determined. The wave length may be 5715.2.

5890.0 and 5896.0. Fraunhofer's line D. The intensities given to these lines in α Orionis have been estimated from a plate taken with a somewhat lower dispersion. They are probably too small.

CHAPTER VI.

LINES IN STARS OF DIVISION *c*.

TABLE VII. shows the distribution and intensity of the miscellaneous stellar lines in spectra belonging to Division *c* in Groups VI., VII., VIII., XII., and XIII. Stars intermediate between Groups VI. and VII. have also been represented, since they are of interest in establishing the continuity of the series of stars belonging to Division *c* from the Orion groups to those of the first type. Aside from the Orion groups, those given above are the only groups in which stars of Division *c* were found.

The first column gives the designations of the lines of hydrogen and calcium.

The second gives the wave lengths, which have ordinarily been obtained by identification with solar lines. Seventeen faint lines, however, apparently do not coincide with solar lines or bands. Their wave lengths have been determined by interpolation and comparison with micrometric measures.

Several Orion lines which are present in Group VIII. have been included in this table, with a remark. Those not found beyond Group VII. have been omitted, as their entire distribution is shown in Table IV. The third column gives the intensities of the lines as found in β Orionis of Group VI. The fourth gives the intensity as found in the stars H. P. 551 and 4 Lacertæ, intermediate between Groups VI. and VII. The fifth gives the intensities for η Leonis of Group VII., the sixth for α Cygni of Group VIII., the seventh for ε Aurigæ of Group XII., the eighth for δ Canis Majoris of Group XIII. All the above stars have been photographed with four prisms, except η Leonis, and the stars intermediate between Groups VI. and VII., which were not bright enough to be satisfactorily photographed with more than two prisms. The plates taken with four prisms have, however, been supplemented by plates taken with three prisms for the region of the K line in δ Canis Majoris and ε Aurigæ, since this region was faint in the plates taken with four prisms. The plates having the above dispersions were too faint for lines having wave lengths shorter than 3934 in the case of δ Canis Majoris, and for those having wave lengths shorter than 3878 in the case of ε Aurigæ, and for those having wave lengths shorter than 3835 in the case of α Cygni. Some lines in the regions not covered by these plates have been obtained from plates taken with two prisms and with one prism; but the study of these regions is necessarily less complete, and the intensities given for the lines are somewhat uncertain. This applies more especially to the case of ε Aurigæ and δ Canis Majoris, since in these stars the lines are more crowded. In the case of the stars of the first type and those of the Orion type belonging to Division *c*, the number of lines found is not so greatly diminished by the use of fewer prisms as it would be in stars of Division *a*, on account of the greater intensity and clearness that prevail among the lines of Division *c*. Thus, in the star η Leonis, and in those intermediate between Groups VI. and VII., the number of lines given for the entire spectrum studied from plates taken with two prisms is probably almost as complete as in the case of the stars photographed with four prisms.

On a plate of β Orionis taken with four prisms, and used in forming this table, the spectrum extends as far as wave length 3692. The intensities have been estimated in a manner similar to that used in the construction of the preceding tables, though the scale on which the estimates are based may not be precisely the same as in those tables.

In these columns, as in the preceding tables, an interrogation point indicates that a doubtful trace of a line was seen; a zero indicates that the line was invisible in good plates; a dot, that the presence or absence of a line is undetermined, as in some portions of the ultra-violet, where the image is too faint to show the line in question.

A number placed between two lines indicates that the two spectral lines having the wave lengths between which it stands are united in a band of the given intensity.

The table shows that the number and general intensity of the lines of Division *c* increase from the Orion to the second type groups. It also shows that the relative intensity of these lines differs from those of corresponding wave lengths given in Table V. for stars of Division *a*, and that there are more lines of great intensity, while the entire number of lines present is somewhat less than in the corresponding groups of stars belonging to Division *a*.

The true identity of many of the lines of stars of Division *c* with the solar lines with which they appear to coincide is more doubtful than that of stars belonging to Division *a*, owing to disagreement in intensity between many of the lines in Division *c* and the corresponding solar lines. In such cases the wave lengths given in Tables V. and VII. sometimes differ.

The hydrogen lines from Hτ to Hλ are also present, but are not included in the table.

TABLE VII.

LINES IN STARS OF DIVISION *c*.

Desig.	Wave Length.	VI.	VI.-VII.	VII.	VIII.	XII.	XIII.	Desig.	Wave Length.	VI.	VI.-VII.	VII.	VIII.	XII.	XIII.
Hκ	3750.2	20	25	45	25	·	·		3982.0	0	0	0	1	4	6
	3758.8	2	1	2	6	·	·		3987.0	0	0	0	0	3	3
Hι	3770.8	20	25	45	25	·	·		3991.6	0	0	0	0	3	2
	3782.0	0	.	?	2	·	·		3995.5	0	0	0	0	0	3
Hθ	3798.1	20	25	45	25	13 ?	·		3997.6	0	0	0	1	2	6
	3814.9	0	?	2	4	7	4		3998.8	0	0	0	0		
	3819.2	6	4	2	1	0	·		4003.0	0	0	2	3	4	3
	3826.0	0	1	1	3	?	?		4005.3	0	0	0	2	4	4
Hη	3835.5	20	25	45	25	13 ?	11 ?		4009.4	0	0	0	1	1	1
	3846.0	0	0	0	2	0	0		4012.6	0	0	?	2	4	3
	3850.0	0	0	0	2	1	2		4014.7	0	0	0	0	2	3
	3854.2	4	?	?	3	0	0		4015.8	0	0	0	1	?	0
	3856.2	6	3	4	4	0	0		4018.4	0	0	0	0	0	2
	3860.0	0	0	0	2	?	3		4022.0	0	0	0	0	0	2
	3863.2	5	3	3	3	0	0		4024.8	0	0	0	2	4	5
	3865.7	0	0	0	1	?	0		4028.5	0	0	0	2	3	2
	3872.7	1	1	1	2	3	7		4030.8	0	0	0	1	2	5
	3878.5	0	0	0	2	3	5		4033.2	0	0	0	2	2	2
	3883.2	0	0	0	1	1	3 ?		4034.6	0	0	0	0	0	1
Hζ	3889.1	20	25	45	25	13	11 ?		4035.8	0	0	0	?	2	1
	3899.9	0	0	0	0	1	2		4037.2	0	0	0	0	?	1
	3900.7	0	1	2	4	7	7		4040.8	0	0	0	1	1	2
	3903.1	0	0	0	2	2	3		4045.9	0	0	0	2	4	4
	3905.6	?	1	2	4	0	0		4048.9	0	0	0	2	1	1
	3906.6	0	0	0		3	4		4050.8	0	0	0	0	1	1
	3913.6	0	1	2	4	6	3		4052.6	0	0	0	2	1	1
	3930.3	0	0	0	2				4053.8	0	0	0	2	3	2
K	3933.8	9	9	10	13	100	220		4057.8	0	0	0	1	?	0
	3936.0	0	0	0	2				4059.0	0	0	0	0	?	1
	3938.5	0	0	0	2	3			4063.7	0	0	1	2	3	7
	3944.1	0	0	0	0	0	3		4067.0	1	0	1	2	2	5
	3945.2	0	0	0	2	3			4071.9	0	0	0	2	3	4
	3949.0	0	0	0	0	0	3		4075.0	0	0	0	?	?	1
	3953.0	0	0	0	1	3	4		4077.9	0	0	?	2	4	8
	3956.6	0	0	0	0	1	2		4083.8	0	0	0	0	?	2
	3958.4	0	0	0	1	1	2		4085.4	0	0	0	0	0	1
	3961.6	0	0	0	2	2	3		4087.2	0	0	0	0	1	3
	3964.5	0	0	0	1	·			4090.2	0	0	0	0	0	1
H	3968.6	7	9	9	12	75	180		4092.7	0	0	0	0	0	1
Hε	3970.2	20	25	45	25				4096.2	0	0	0	0	0	2
	3973.8	0	0	0	2	3			4098.5	0	0	0	0	0	1
	3976.8	0	0	0	0	0	2	Hδ	4101.8	20	25	45	25	13	11
	3979.7	0	0	0	2	0	0		4106.6	0	0	0	0	0	1

Desig.	Wave Length.	VI.	VI.-VII.	VII.	VIII.	XII.	XIII.	Desig.	Wave Length.	VI.	VI.-VII.	VII.	VIII.	XII.	XIII.
	4110.4	0	0	0	0	1	4		4247.3	0	0	0	2	3	4
	4111.0	0	0	?	1	?	?		4251.0	0	0	0	1	1	2
	4113.1	0	0	0	0	1	1		4253.0	0	0	0	1	?	?
	4114.7	0	0	0	0	0	1		4254.5	0	0	0	?	1	2
	4118.9	0	0	0	1	1	4		4258.7	0	0	0	2	2	2
	4122.8	0	0	1	2	2	3		4260.5	0	0	0	0	1	2
	4128.1	3	4	4	3	2	5		4262.2	0	0	0	2	1	1
	4128.5								4270.0	0	0	0	?	1	1
	4131.4	3	4	4	3	0	0		4271.7	0	0	0	0	2	4
	4132.2	0	0	0	0	2	3		4273.8	0	0	?	1	1	1
	4134.8	0	0	0	0	0	3		4275.0	0	0	1	1	2	3
	4137.4	0	0	0	1	1	3		4278.4	0	0	1	1	1	1
	4143.9	3	3	3	1	1	5		4280.5	0	0	0	0	0	1
	4146.0	0	0	0	1	?	0		4282.9	0	0	0	0	0	1
	4149.5	0	0	0	?	2	2		4284.4	0	0	0	1	1	1
	4154.9	0	0	0	0	1	2		4288.1	0	0	0	1	2	2
	4156.7	0	0	0	0		2		4289.8	0	0	0	2	3	4
	4161.7	0	0	0	1	2	3		4294.3	0	0	0	2	2	2
	4163.9	1	1	1	2	2	2		4297.1	0	0	0	2	2	2
	4167.5	0	0	0	1	3	1		4300.2	0	2	1	3	4	5
	4172.9	0	0	0	2	6	13		4302.6	0		1	3	5	5
	4173.6	1	2	5	5				4305.8	0	0	0	0	0	1
	4177.8	0	0	0	1	7	3		4308.0	0	0	1	2	2	2
	4179.5	1	3	5	5		4		4309.5	0	0	0	0	1	2
	4182.0	0	0	0	1	0	1		4314.3	0	0	0	1	4	2
	4185.0	0	0	0		1	2		4315.2	0	0	2	3	5	5
	4187.6	0	0	0	2	1	4		4317.0	0	0	0	0	1	1
	4191.8	0	0	0	?	?	3		4317.6	0	0	0	0	0	1
	4196.8	0	0	0	0	0	3		4321.0	0	0	0	2	3	3
	4198.5	0	0	0	1	1	4		4326.0	0	0	0	2	4	5
	4202.2	0	0	0	1	1	3		4330.9	0	0	0	1	3	2
	4205.3	0	0	0	1	1	3		4333.0	0	0	0	0	0	1
	4206.9	0	0	0	0	0	2		4337.6	0	0	0	1	6	10
	4208.8	0	0	0	0	0	2	Hγ	4340.7	20	25	45	25	13	11
	4210.5	0	0	0	0	0	2		4344.7	0	0	0	1	2	1
	4212.1	0	0	0	0	0	1		4352.0	2	3	4	4	4	5
	4215.7	0	0	0	1	4	5		4355.3	0	0	0	0	0	1
	4217.6	0	0	0	0	0	1		4359.9	0	0	0	0	1	3
	4219.6	0	0	0	0	0	1		4367.9	0	0	0	?	1	1
	4222.4	0	0	0	0	0	1		4368.7	0	0	0	2	0	?
	4224.7	0	0	0	0	0	1		4370.0	0	0	?	?	1	1
	4227.0	0	0	0	0	3	5		4371.5	0	0	?	0	1	1
	4233.6	2	4	5	5	5	3		4374.7	0	0	0	1	4	9
	4236.0	0	0	0	0	1	2		4376.1	0	0	0	0	0	
	4240.0	0	0	0	0	1	3		4379.4	0	0	0	0	1	1
	4242.5	0	0	1	2	2	1		4383.7	0	0	0	1	4	8

Desig.	Wave Length.	VI.	VI.-VII.	VII.	VIII.	XII.	XIII.	Desig.	Wave Length.	VI.	VI.-VII.	VII.	VIII.	XII.	XIII.
	4385.2	0	2	4	3	4	4		4564.0	0	0	0	2	3	4
	4390.5	0	0	0	2	1	2		4572.2	.	0	?	2	3	3
	4395.3	0	0	1	3	5	7		4576.5	0	0	0	2	1	1
	4400.2	0	0	0	2	3	7		4580.0	0	0	0	1	1	1
	4405.0	0	0	0	1	1	2		4584.0	2	2	3	4	4	5
	4408.5	0	0	0	0	0	2		4586.1	0	0	0	2	2	1
	4411.5	0	0	0	?	1	2		4592.8	0	0	0	0	0	1
	4415.3	0	0	0	0	0	4		4595.9	0	0	0	0	0	2
	4417.9	0	2	3	4	7	6		4613.5	0	0	0	0	0	1
	4422.8	0	0	0	0	1	3		4616.9	0	0	0	0	1	1
	4427.4	0	0	0	0	0	2		4619.2	0	1	2	3	3	4
	4430.8	0	0	0	0	0	2		4625.8	0	0	0	0	0	1
	4435.2	0	0	0	0	0	2		4629.9	?	1	2	3	3	4
	4442.5	0	0	0	0	0	9		4634.8	0	0	2	3	2	1
	4444.0	0	0	1	3	6			4639.1	0	0	0	0	0	1
	4447.7	0	0	0	0	0	1		4646.3	0	0	0	0	0	1
	4450.6	0	0	0	2	3	3		4648.9	0	0	0	0	0	1
	4455.0	0	0	0	1	1	2		4657.0	0	0	0	2	2	4
	4460.0	0	0	0	0	0	1		4663.7	0	0	0	0	1	2
	4462.0	0	0	0	1	1	2		4668.0	0	0	1	1	1	3
	4464.8	0	0	0	0	1	1		4670.0	0	0		1	1	3
	4469.5	0	0	0	3	4	3		4679.0	0	0	0	0	0	1
	4471.0	0	0	0	0	0	2		4682.2	0	0	0	0	0	1
	4471.8	4	3	2	2	0	0		4691.6	0	0	0	0	0	1
	4473.0	0	0	0	0	0	1		4698.8	0	0	0	0	0	2
	4476.2	0	0	0	0	0	1		4703.1	0	0	0	0	0	2
	4482.0	5	5	5	5	5	4		4709.0	0	0	0	0	1	3
	4489.6	0	1	3	3	2	3		4714.5	0	0	0	0	0	1
	4491.6	0			3	1	3		4720.5	0	0	0	0	0	1
	4494.8	0	0	0	0	1	2		4727.6	0	0	0	0	0	1
	4497.0	0	0	0	0	0	2		4731.7	0	0	0	2	2	1
	4501.5	0	0	0	2	4	4		4737.0	0	0	0	0	0	1
	4508.5	1	2	3	3	4	3		4754.2	0	0	0	0	0	1
	4515.4	?	1	2	3	3	2		4756.4	0	0	0	0	?	?
	4520.3	?	2	3	3	2	1		4764.1	0	0	0	0	2	8
	4522.9	1	2	3	3	2	1		4771.8	0	0	0	0	0	1
	4525.3	0	0	0	0	0	1		4780.1	0	0	0	0	2	1
	4528.8	0	0	0	0	2	2		4786.8	0	0	0	0	0	1
	4531.2	0	0	0	0	0	1		4798.7	0	0	0	0	0	2
	4534.2	0	1	2	3	3	4		4805.2	0	0	0	0	2	3
	4541.6	0	1	1	2	2	2		4808.0	0	0	0	0	0	2
	4544.9	0	0	0	0	0	2		4824.0	0	0	1	2	2	5
	4549.7	2	3	4	4	4	3		4836.0	0	0	0	0	1	1
	4554.2	0	0	0	0	?	5		4848.4	0	0	?	2	2	3
	4556.0	0	0	2	3	4			4855.7	0	0	0	0	1	3
	4558.9	0	0	0	2	2	1	Hβ	4861.5	20	25	45	25	13	11

REMARKS.

3758.8. The wave length of this line is somewhat uncertain.

3782.0. The wave length of this line is somewhat uncertain.

3819.2. This is an Orion line.

3854.2. This is an Orion line. Its intensity in η Leonis of Group VII., and in stars intermediate between Groups VI. and VII., could not be determined, because in the photographs of these stars, which were not of the greatest dispersion, it could not be distinctly separated from the line 3856.2.

3856.2. This is an Orion line.

3860.0. The wave length of this line is somewhat uncertain.

3863.2. This is an Orion line.

3872.7. The Orion line 3872.4 is indistinguishable from this solar line. The Orion line is the one present in the stars of Groups VI. and VII., and in those intermediate between VI. and VII. It is uncertain whether it is present in combination with 3872.7 in the remaining groups given in the table.

3906.6. The intensity given for this line in Group XIII. was obtained from a plate taken with four prisms. In the plate taken with two prisms it appeared as a band having intensity 8, this intensity being due to combination with a line of greater wave length.

3916.4, 3918.6, 3920.4, and 3923.0 are well defined in γ Cygni and faint in δ Canis Majoris. 3923.0 occurs also in ε Aurigæ.

3933.8. The intensity of this line in ε Aurigæ of Group XII. is the average intensity as seen in plates having different dispersions. The estimated intensity or width varies from 50 to 100, according to dispersion, being least under the greatest dispersion. It is, however, uncertain how far the apparent narrowness of the band, as seen in the plate taken with four prisms, is due to photographic effect. In ε Aurigæ the lines 3930.3 and 3936.0 are included in the K band. In δ Canis Majoris lines 3930.3, 3936.0, and 3938.5 are included.

3968.6 and 3970.2. The intensity of this compound band given for ε Aurigæ of Group XII. is the average of the estimates from plates taken with three different dispersions. As in the case of the K line, the estimated width varies greatly according to the dispersion, being greatest under the smallest dispersion. Its apparent narrowness in the plate taken with four prisms may be due to photographic defect. In δ Canis Majoris the lines 3964.5 and 3973.8 are included in the band.

4128.1 and 4128.5. The second of these is an Orion line; the two are so close that it is hardly possible to distinguish them. In β Orionis it is the Orion line which is present. In ε Aurigæ and δ Canis Majoris it appears to be the solar line 4128.1. In the stars of the remaining groups it is doubtful which is present, and both may be included.

4131.4 This is an Orion line.

4143.9. In stars of Groups VI. and VII., and in those intermediate, the line present is the Orion line, 4144.0, which is indistinguishable from the double solar line whose centre is at 4143.9. The latter is assumed to be present in the stars of Group XIII. In stars of Groups VIII. and XII. it is uncertain which is present.

4172.9 and 4173.6. The band in which these two lines are combined is wider in δ Canis Majoris than in ε Aurigæ or α Cygni.

4208.8. This line is present in γ Cygni, but not in δ Canis Majoris.

4359.9. In ε Aurigæ the line is faint and hazy, and its centre appears to have the wave length 4360.2.

4367.9 and 4370.0. In α Cygni these lines may be present in combination with 4368.7.

4471.8. This is an Orion line.

4482.0. The Orion line 4481.4 is here combined with the solar line 4482.5. In the stars of Groups VI. and VII., and those intermediate between the two, it is the Orion line which is present. In the remaining stars the two may be united.

4613.5. This line is clearly visible in γ Cygni. In δ Canis Majoris it is absent or extremely faint.

CHAPTER VII.

RELATIVE INTENSITIES OF LINES.

TABLE VIII. shows roughly the relation of the intensities of the four classes of lines to one another in stars of Division *a* from Group II. to Group XVIII.

The first column gives the group numbers. The second column gives for each group the estimated intensity of the hydrogen lines in hundredths of their maximum intensity as seen in *α* Canis Majoris. The third gives the sum of the estimated intensities of the Orion lines of each group. The fourth gives the sum of the intensities of the solar lines between Hβ and Hϵ for as many groups as are represented in Tables IV. and V. The fifth column gives the estimated intensity of the K line in each group.

It is to be regretted that the sum of the intensities of the solar lines could not be obtained for all the groups, owing to the fact that in some of them there were no stars bright enough to be satisfactorily photographed with four prisms, and therefore these groups could not be rendered comparable with the others.

A comparison of the spectra of all the groups photographed with one or two prisms, however, leaves no doubt that the increase in the sum of the intensities is continuous throughout.

It should be stated that the numbers here given do not adequately represent the amount of this increase, because the estimates for the individual lines did not represent all the intermediate degrees of intensity.

The table shows that the intensity of the lines of hydrogen increases, attains a maximum in Groups VI. and VII., and then steadily decreases. It further shows that the aggregate intensity of the Orion lines is at a maximum in Group III., then decreases at first somewhat suddenly, and that these lines disappear in Group VIII., except that one faint line persists as far as Group XII.

The aggregate intensity of the solar lines is shown to increase steadily from Groups II. to XVIII., while the estimated intensity of K, except in Group III., shows a steady increase to Groups XV. and XVI., and afterwards a probable slight decrease.

It should be stated of the doubtful lines 4144.0 and 4481.4, that the former has been included among the solar, the latter among the Orion lines.

TABLE VIII.

RELATIVE INTENSITIES OF LINES.

Group.	Intensity of Hydrogen.	Intensity of Orion Lines.	Intensity of Solar Lines.	Intensity of K Line.	Group.	Intensity of Hydrogen.	Intensity of Orion Lines.	Intensity of Solar Lines.	Intensity of K Line.
II.	20	148	1	2	XI.	60	1	...	83
III.	35	162	1	1	XII.	25	1	432	135
IV.	45	151	2	3	XIII.	20	0	...	160
V.	90	51	3	4	XIV.	16	0	568	160
VI.	100	36	43	6	XV.	9	0	712	200
VII.	100	5	99	8	XVI.	7	0	...	200 ?
VIII.	95	1	164	13	XVII.	7	0	...	200 ?
IX.	95	1	...	28	XVIII.	6	0	860	170 ?
X.	90	1	...	58					

CHAPTER VIII.

CLASSIFICATION OF SPECTRA.

TABLE IX. shows the classification, in order of groups, of the six hundred and forty bright stars included in the series. The eight stars of the fourth and fifth types, the true position of which in the series is not known with certainty, have been appended as Groups XXI. and XXII.

In the first column the group number is given. When a number is placed in Italics, it indicates that the stars lie between that and the following group. The second column gives the letter designating each of the divisions *a*, *b*, and *c*, and the intermediate divisions *ab* and *ac*. The expression *a*, *b* signifies that it is doubtful to which of the divisions *a* or *b* the star in question belongs. The letter ***P*** signifies that a star is peculiar. The division letter has been repeated for every star, the absence of such letter implying that the division is undetermined. It is also omitted in the case of stars of the fourth and fifth types, since these have not been included in the series.

The third column of the table gives the designation of each star in the Harvard Photometry, or for stars not included in that catalogue, the zone and number from the Bonn or Cordoba Durchmusterung. A number in Italics denotes a pair of adjacent stars. The fourth column gives the constellation, and the fifth, the letter or Flamsteed number designating the star. The numbers in the sixth column refer to the series of Remarks on Individual Stars, beginning on page 94.

TABLE IX.

CLASSIFICATION OF SPECTRA.

Group.	Div.	Cat. No.	Constellation.	Desig	Remarks.	Group.	Div.	Cat. No.	Constellation	Desig	Remarks.
I.	b	1256	Monocer.	S	1	IV.	a	1090	Orion	57	
“	b	1027	Orion	ι	2	“	a	799	Eridanus	ν	26
“	b	*1019*	Orion	λ		“	a	418	Cetus	δ	10
“	b	1023	Orion	41	3	“	a	1368	Can. Maj.	27	10
“	b	652	Perseus	ξ	4	“	a	3051	Hercules	102	10
“	b	3750	Cygnus	A		“	b	2338	Urs. Maj.	η	
“	b	3821	Cepheus	—	5	“	b	3199	Sagittar.	σ	
II.	a	1029	Orion	ε		“	b	657	Taurus	λ	
“	a	1068	Orion	κ		“	b	2959	Hercules	ι	
“	a	1017	Orion	ϕ^1	2,6	“	b	2662	Scorpius	ρ	23
“	a	649	Perseus	ε	2	“	b	3530	Vulpec.	—	
“	b	1005	Orion	δ		“	b	3622	Delphin.	—	
“	b	*1045*	Orion	ζ		“	b	3207	Lyra	δ^1	
“	b	2788	Ophiuch.	ζ	2,7	“	b	1047	Orion	—	
“	b	1039	Orion	σ	8	“	b	647	Perseus	—	23
“	b	1043	Orion	—	9	“	b	4153	Cassiop.	—	
“	a, b	4086	Cassiop.	1	10	“	a, b	1153	Orion	ξ	
“	a, b	2738	Scorpius	σ	10	“	a, b	1132	Orion	ν	
“	a, b	2783	Scorpius	τ	2	“	a, b	3342	Cygnus	2	11
“	a, b	71	Cassiop.	κ	11	“	a, b	*1445*	Argo	κ	11
“	a, b	934	Auriga	—	12	“	a, b	2601	Scorpius	ο	20
“	P	1859	Leo	ρ	13	“	a, b	1157	Monocer.	—	20
“	P	+56° 3115	Cassiop.	—	14	“	a, b	3191	Lyra	8	
III.	a	1201	Can. Maj.	β		“	a, b	− 5° 1334	Orion	—	20
“	a	975	Orion	η	15	“	a, b	+58° 2546	Cassiop.	—	
“	a	638	Perseus	ζ	16	“	a, b	+59° 2629	Cassiop.	—	20
“	a	3798	Cepheus	β		“	a, b	− 4° 1186	Orion	—	20
“	a	1325	Can. Maj.	ε	17	*IV.*	a	845	Orion	π^4	
“	b	2263	Virgo	α	18	“	a	857	Orion	π^5	
“	b	*2690*	Scorpius	β	19	“	a	668	Taurus	40	
“	b	2671	Scorpius	π		“	b	1195	Can. Maj.	ζ	
“	b	2698	Scorpius	ω^1		“	b	3291	Lyra	η	
“	b	1024	Orion	43	20,21	“	b	1518	Argo	16	23
“	a, b	1021	Orion	—	22	“	ab	896	Auriga	η	
“	a, b	600	Perseus	ο		“	ab	287	Cassiop.	ε	27
“	a, b	1025	Orion	c	23	“	ab	1599	Hydra	η	28
“	a, b	1001	Auriga	χ	24	“	a, b	107	Cassiop.	ο	
“	a, b	3736	Cepheus	—	20	“	a, b	1012	Orion	35	
“	a, b	−4° 1196	Orion	—	20	“	a, b	2587	Libra	—	
“	a, b	−6° 1255	Orion	—	20	“	a, b	105	Cassiop.	—	
“	c	1122	Orion	χ^2		“	a, b	2890	Hercules	u	
“	P	2674	Scorpius	δ	25	“	a, b	555	Perseus	34	20
IV.	a	979	Orion	γ		“	a, b	522	Perseus	31	20
“	a	23	Pegasus	γ		“	a, b	2899	Ophiuch.	θ	
“	a	82	Cassiop.	ζ		“	a, b	552	Perseus	—	

Group.	Div.	Cat. No.	Constellation.	Desig.	Remarks.	Group.	Div.	Cat. No.	Constellation.	Desig.	Remarks.
IV.	*a, b*	521	Perseus	29	20	VI.	*c*	3062	Sagittar.	μ	
"	*a, b*	+8° 1016	Orion	—		*VI.*	*b*	3994	Aquarius	η	
V.	*a*	618	Taurus	η		"	*b*	3624	Delphin.	α	
"	*a*	2878	Draco	ζ	10	"	*ab*	4007	Pisc. Aus.	ε	
"	*a*	3592	Delphin.	ε	10	"	*c*	551	Camelop.	—	35
"	*a*	1340	Can. Maj.	γ	10	"	*c*	553	Camelop.	—	36
"	*a*	613	Taurus	20		"	*c*	3962	Lacerta	4	37
"	*a*	610	Taurus	q		"	*c*	3069	Sagittar.	15	38
"	*a*	608	Taurus	17	29	VII.	*a*	1275	Can. Maj.	α	39
"	*a*	615	Taurus	23	29	"	*a*	3147	Lyra	α	40
"	*a*	2745	Hercules	τ		"	*a*	2638	Serpens	μ	41
"	*b*	948	Orion	τ		"	*a*	2844	Hercules	ε	42
"	*b*	591	Perseus	δ		"	*a*	2381	Draco	α	43,44
"	*b*	69	Cassiop.	λ	30	"	*a*	3950	Aquarius	γ	
"	*b*	77	Cassiop.	—	30	"	*a*	2506	Libra	δ	
"	*b*	+3° 420	Cetus	—	23	"	*a*	1965	Leo	σ	42
"	*a, b*	625	Taurus	27		"	*a*	3514	Aquila	θ	43
"	*a, b*	537	Perseus	—		"	*a*	2713	Hercules	φ	45
"	*a, b*	470	Perseus	—		"	*a*	3232	Lyra	γ	42,46,41
"	*a, b*	+49° 944	Perseus	—		"	*a*	3361	Cygnus	7	30
"	*a, b*	+24° 4471	Pegasus	—	31	"	*a*	3445	Aquila	58	22,30
"	*a, b*	+23° 505	Taurus	—		"	*b*	3048	Hercules	o	
"	*a, b*	+ 1° 886	Orion	—	30	"	*b*	3259	Aquila	ζ	47
"	*a, b*	+ 9° 1927	Cancer	—	20	"	*b*	2120	Corvus	δ	48
"	*c*	1399	Can. Maj.	η		"	*b*	1676	Hydra	θ	
"	*c*	1337	Can. Maj.	o^2		"	*b*	1554	Monocer.	30	43,49
"	*c*	3017	Ophiuch.	67		"	*b*	361	Triangul.	γ	49
VI.	*a*	496	Perseus	β		"	*b*	2979	Ophiuch.	γ	
"	*a*	978	Taurus	β	32	"	*b*	3023	Ophiuch.	68	20
"	*a*	3157	Sagittar.	φ		"	*b*	3419	Cygnus	δ	50,42
"	*a*	2078	Corvus	γ	33	"	*b*	3260	Aquila	λ	42,51
"	*b*	1797	Leo	α		"	*b*	2787	Hercules	σ	52,43,53
"	*b*	1403	Can. Min.	β		"	*b*	356	Triangul.	7	
"	*b*	2539	Libra	β		"	*b*	3552	Capricor.	ν	23
"	*b*	554	Taurus	ξ		"	*b*	*2914*	Hercules	ρ	
"	*b*	579	Eridanus	τ^6		"	*b*	+82° 235	Camelop.	—	30
"	*b*	3520	Vulpec.	20	23	"	*b*	+48° 722	Perseus	—	
"	*b*	145	Cassiop.	—	2,23	"	*b*	−11° 2925	Hydra	—	54
"	*ab*	445	Aries	41		"	*a, b*	1150	Orion	68	55,42
"	*ab*	4013	Pegasus	ζ	2	"	*a, b*	906	Eridanus	66	20
"	*a, b*	1119	Orion	64		"	*a, b*	1613	Hydra	ρ	23
"	*a, b*	+22° 563	Taurus	—		"	*a,*	2852	Hercules	*33*	20
"	*a, b*	+23° 563	Taurus	—	30	"	*a,*	23° 553	Taurus	—	30
"	*a, b*	+24° 553	Taurus	—		"	*a, b*	+23° 569	Taurus	—	20
"	*a, b*	+24° 556	Taurus	—	30	"	*a, b*	+23° 561	Taurus	—	20
"	*a, b*	+46° 773	Perseus	—	20	"	*a, b*	+23° 536	Taurus	—	23,30
"	*a, b*	+47° 844	Perseus	—	20	"	*a, b*	+24° 562	Taurus	—	20
"	*a, b*	+47° 846	Perseus	—	12	"	*a, b*	+44° 634	Perseus	—	30
"	*a, b*	+24° 546	Taurus	—	34	"	*a, b*	+47° 847	Perseus	—	43
"	*c*	936	Orion	β		"	*a, b*	+23° 1347	Gemini	—	23

Group.	Div.	Cat. No.	Constellation	Desig	Remarks.	Group.	Div.	Cat. No.	Constellation.	Desig.	Remarks.
VII.	a, b	+82° 253	Camelop.	—	20	VIII.	a, b	+43° 3132	Lyra	—	20, 22
"	c	1793	Leo	η		"	a, b	+44° 3017	Lyra	—	20
"	P	3120	Draco	φ	43, 44	"	a, b	+65° 335	Camelop.	—	
VIII.	a	*1423*	Gemini	α		"	a, b	+65° 338	Camelop.	—	
"	a	1100	Auriga	β	56	"	c	3631	Cygnus	α	
"	a	*2264*	Urs. Maj.	ζ	56	"	P	2191	Urs. Maj.	ε	66
"	a	1923	Urs. Maj.	β	32	"	P	5	Androm.	α	67
"	a	1249	Gemini	γ		"	P	929	Lepus	μ	68
"	a	665	Taurus	ν		"	P	*2195*	Can. Ven.	12	69
"	a	1951	Leo	θ	32	"	P	1104	Auriga	θ	70
"	a	3647	Aquarius	ε		"	P	2298	Urs. Maj.	81	71
"	a	306	Cassiop.	50		"	P	*291*	Aries	γ	72
"	a	2773	Ophiuch.	λ	57	*VIII.*	ac	1462	Argo	τ	
"	a	1810	Urs. Maj.	λ		IX.	b	2077	Urs. Maj.	δ	32, 177
"	a	2893	Hercules	e	58	"	b	2294	Virgo	ζ	177
"	a	2088	Virgo	η		"	b	3527	Cygnus	30	23, 177
"	a	2645	Serpens	ε	59	"	b	910	Eridanus	β	178
"	a	2868	Ophiuch.	η		"	b	2025	Leo	β	178
"	a	3913	Pegasus	θ	60	"	b	1949	Leo	δ	178
"	a	763	Taurus	68		"	b	2267	Urs. Maj.	g	178
"	a	1925	Leo	b	61	"	b	2566	Urs. Min.	γ	178
"	a	4015	Pegasus	o	62	"	b	2632	Serpens	β	73, 178
"	a	3550	Cygnus	36		"	ab	4057	Pisc. Aus.	α	177
"	a	+41° 1044	Auriga	—	60	"	ab	2480	Libra	α	177
"	a	−10° 704	Eridanus	—	63	"	ab	1295	Gemini	θ	178
"	a	− 7° 3946	Libra	—	54	"	a, b	3045	Ophiuch.	72	177
"	b	2036	Urs. Maj.	γ	32	"	a, b	304	Cassiop.	A	177
"	b	1100	Auriga	β	56	"	a, b	1065	Lepus	ζ	23, 177
"	b	*2264*	Urs. Maj.	ζ	56	"	a, b	487	Eridanus	τ^2	177
"	b	1645	Urs. Maj.	κ		"	a, b	1373	Gemini	λ	177
"	b	1715	Urs. Maj.	26	54	"	a, b	4047	Aquarius	δ	32, 177
"	b	4080	Pegasus	α	32, 64	"	a, b	4099	Cassiop.	2	177
"	b	2468	Virgo	109	32	"	a, b	756	Taurus	64	177
"	b	1588	Hydra	δ	32, 50	"	a, b	+83° 20	Cepheus	—	177
"	b	433	Cetus	γ		"	a, b	1973	Crater	γ	178
"	b	180	Cepheus	—		"	a, b	148	Androm.	μ	178
"	b	2880	Hercules	δ	2	"	a, b	783	Taurus	—	30, 178
"	b	3424	Sagitta	ζ	60	"	a, b	3365	Cygnus	ι	74, 178
"	b	1359	Monocer.	22	32	"	a, b	3896	Aquarius	32	178
"	b	3600	Delphin.	ζ	54, 60	"	a, b	3053	Hercules	101	178
"	b	332	Aries	κ	23	"	a, b	3635	Delphin.	δ	20, 178
"	b	3987	Lacerta	7		"	a, b	4076	Androm.	2	178
"	b	3515	Vulpec.	18		"	—	752	Taurus	63	
"	b	−24° 4553	Can. Maj.	—	23	"	—	1409	Gemini	64	20
"	b	−24° 4565	Can. Maj.	—	23	"	—	3192	Lyra	ν	65
"	ab	2594	Corona	α	51	"	—	+44° 3889	Cygnus	—	
"	ab	2625	Corona	γ	51	"	—	− 4° 1167	Orion	—	
"	ab	1681	Lynx	38	55, 60	X.	a	336	Triangul.	β	75, 179
"	a, b	172	Cetus	28	65	"	a	295	Aries	β	32, 76, 179
"	a, b	+58° 608	Camelop.	—	23, 2?	"	b	3429	Aquila	α	180

Group.	Div.	Cat. No.	Constellation.	Desig.	Remarks.	Group.	Div.	Cat. No.	Constellation.	Desig.	Remarks.
X.	b	3757	Cepheus	α	180	XII.	a	289	Triangul.	α	
"	b	2944	Ophiuch.	α	180	"	a	1969	Leo	ι	
"	ab	219	Cassiop.	δ	179	"	a	3907	Pegasus	ι	
"	ab	1636	Urs. Maj.	ι	180	"	a	2457	Virgo	μ	
"	a, b	4001	Lacerta	9	179	"	a	1641	Urs. Maj.	10	84
"	a, b	3319	Sagittar.	ρ	180	"	a	*3970*	Aquarius	ζ	32
"	a, b	776	Taurus	θ^2	180	"	a	4024	Pegasus	ξ	
"	a, b	2947	Serpens	ξ	180	"	a	3171	Hercules	110	2
"	a, b	806	Eridanus	c	180	"	a	4238	Pisces	ω	
"	a, b	2070	Draco	—	77,180	"	a	1101	Lepus	η	85
"	a, b	+47° 850	Perseus	—	20,180	"	a	701	Eridanus	o^1	32,86
"	a, b	3942	Cephius	ε	181	"	a	3071	Draco	40	87
"	a, b	437	Cetus	μ	2,181	"	a	3072	Draco	41	87
"	a, b	854	Eridanus	ω	181	"	a	915	Eridanus	68	
"	a, b	3848	Capricor.	δ	181	"	a	1162	Orion	71	2
"	a, b	+23° 556	Taurus	—	20,181	"	a	1821	Leo	40	31
XI.	ab	2436	Boötes	γ	182	"	a	2479	Libra	8	31
"	ab	1377	Gemini	δ	182	"	a	1272	Gemini	ξ	
"	ab	−0° 1634	Monocer.	—	182	"	a	1831	Camelop.	—	88
"	ab	*2155*	Virgo	γ	183	"	a	3420	Cygnus	17	
"	a, b	3343	Aquila	δ	182	"	a	+37° 1347	Auriga	—	20
"	a, b	2747	Hercules	γ	182	"	a	+60° 1136	Urs. Maj.	—	31
"	a, b	1405	Gemini	ρ	182	"	a	+23° 2207	Leo	—	31
"	a, b	4104	Androm.	7	182	"	a	+47° 466	Perseus	—	20
"	a, b	1026	Orion	c	182	"	ab	9	Cassiop.	β	
"	a, b	2481	Boötes	—	20,182	"	c	877	Auriga	ε	
"	a, b	+24° 4540	Pegasus	—	182	"	ac	602	Perseus	ν	
"	a, b	1701	Urs. Maj.	h	78,183	*XII.*	c	3551	Cygnus	35	89
"	a, b	2207	Urs. Maj.	78	183	"	ac	541	Perseus	α	
"	ac	13	Androm.	22	183	"	ac	3583	Cygnus	41	
"	ac	3010	Hercules	ν	183	XIII.	a	1089	Orion	χ^1	
"	P	2572	Corona	β	79,182	"	a	2028	Virgo	β	
"	—	+12° 1275	Gemini	—	80,182	"	a	120	Cassiop.	η	90
XI.	ab	1812	Leo	ζ		"	a	1608	Hydra	ε	
"	a, b	3741	Cygnus	τ		"	a	2426	Boötes	θ	
"	a, b	2442	Boötes	σ	30	"	a	1057	Lepus	γ	
"	ac	1014	Lepus	α		"	a	2696	Draco	θ	
"	ac	3270	Sagittar.	π		"	a	3122	Draco	χ	
"	ac	1753	Urs. Maj.	υ		"	a	*1521*	Cancer	ζ	
"	—	2128	Corvus	η	30,81	"	a	*2688*	Scorpius	ξ	
"	—	4002	Cepheus	31	81	"	a	840	Orion	π^3	
"	—	3407	Cygnus	—	30,81	"	a	1655	Urs. Maj.	σ^2	32
"	—	+27° 1374	Gemini	—	22,31	"	a	3047	Hercules	b	20
"	—	+79° 36	Cepheus	—	20	"	a	1709	Urs. Maj.	θ	32
"	—	− 0° 1646	Monocer.	—	20	"	a	2666	Serpens	γ	32,91
XII.	a	1442	Can. Min.	α		"	a	179	Cetus	30	34
"	a	1515	Argo	ι	82	"	a	136	Cassiop.	—	
"	a	3843	Pegasus	κ		"	a	1225	Camelop.	—	
"	a	3605	Delphin.	β	83	"	a	913	Camelop.	—	
"	a	3393	Cygnus	θ		"	a	3926	Cepheus	—	

Group.	Div.	Cat. No.	Constellation	Desig.	Remarks.
XIII.	a	1582	Hydra	—	30
"	c	1350	Can. Maj.	δ	
"	c	4224	Cassiop.	ρ	
"	c	3564	Cygnus	γ	
"	c	3136	Draco	d	
"	ac	213	Urs. Min.	α	
XIII.	a	429	Perseus	θ	
XIV.	a	932	Auriga	α	39,92
"	a	—	—	—	The Sun, 186
"	a	2360	Boötes	η	93
"	a	2807	Hercules	ζ	94
"	a	*1959*	Urs. Maj.	ξ	
"	a	702	Perseus	μ	95
"	a	994	Lepus	β	96
"	a	4020	Pegasus	η	97
"	a	2232	Com. Ber.	43	
"	a	1558	Urs. Maj.	o	2
"	a	2937	Draco	β	
"	a	3537	Capricor.	α^1	20
"	a	360	Triangul.	δ	
"	a	3795	Aquarius	β	
"	a	309	Pisces	112	
"	a	1811	Leo	35	20
"	a	2700	Scorpius	ω^2	
"	a	1383	Can. Maj.	—	65
"	a	3225	Lyra	—	
"	ac	3436	Aquila	η	
"	ac	3899	Aquarius	α	
"	ac	876	Camelop.	10	
"	ac	1492	Argo	e	
"	ac	3981	Cepheus	δ	98
"	ac	1205	Monocer.	T	
"	ac	1334	Gemini	ζ	
"	P	1747	Leo	ε	99
"	P	1474	Argo	ξ	100
XIV.	a	1457	Gemini	κ	101
"	a	2976	Hercules	μ	102
"	a	239	Pisces	η	101
"	a	2134	Corvus	β	103
"	a	2249	Hydra	γ	104,101
"	a	2515	Boötes	β	104,101
"	a	2851	Urs. Min.	ε	105
"	a	1263	Gemini	ε	
"	a	2057	Virgo	o	104
"	a	3780	Capricor.	35	101
"	a	*3645*	Delphin.	γ	106,107
"	a	1580	Urs. Maj.	π^1	
"	a	1605	Cancer	ι	108
"	a	530	Eridanus	15	
"	a	696	Eridanus	37	
XIV.	a	1312	Can. Maj.	o^1	109
"	a	550	Taurus	o	
"	a	3541	Cygnus	o^2	110
"	a	+56° 2746	Cepheus	—	105
"	a	2141	Draco	6	
"	a	+ 5° 104	Pisces	—	
"	P	3779	Capricor.	ζ	111
XV.	a	2400	Boötes	α	
"	a	2541	Boötes	δ	184
"	a	4114	Pisces	γ	32,184
"	a	1459	Gemini	β	184
"	a	3648	Cygnus	ε	184
"	a	*1823*	Leo	γ	107,184
"	a	2774	Hercules	β	32,184
"	a	1926	Urs. Maj.	α	184
"	a	93	Pisces	55	184
"	a	3450	Aquila	β	184
"	a	4174	Androm.	λ	112,184
"	a	1963	Crater	δ	184
"	a	2736	Ophiuch.	ε	184
"	a	3656	Cepheus	η	184
"	a	2589	Libra	γ	184
"	a	1961	Urs. Maj.	ν	112,184
"	a	3090	Serpens	η	184
"	a	1086	Lepus	δ	112,184
"	a	3037	Ophiuch.	70	112,184
"	a	1093	Auriga	δ	184
"	a	3447	Draco	ε	184
"	a	812	Eridanus	53	184
"	a	4034	Pegasus	μ	184
"	a	1999	Draco	2	184
"	a	+20° 85	Pisces	—	184
"	a	94	Cassiop.	α	
"	a	2627	Serpens	α	185
"	a	103	Cetus	β	185
"	a	183	Cetus	η	185
"	a	2962	Ophiuch.	β	185
"	a	3007	Hercules	ξ	185
"	a	1902	Leo Min.	46	185
"	a	2838	Ophiuch.	κ	185
"	a	1760	Leo	μ	185
"	a	2208	Virgo	ε	185
"	a	498	Perseus	κ	185
"	a	3328	Draco	τ	185
"	a	45	Cetus	ι	185
"	a	1800	Hydra	λ	185
"	a	1452	Monocer.	26	185
"	a	333	Aries	α	113,185
"	a	3084	Sagittar.	δ	185
"	a	2569	Draco	ι	2,185

Group.	Div.	Cat. No.	Constellation.	Desig.	Remarks.	Group.	Div.	Cat. No.	Constellation.	Desig.	Remarks.
XV.	*a*	3003	Draco	ξ	114?,185	XV.	*a*	1918	Crater	α	
"	*a*	220	Cetus	θ	115,185	"	*a*	443	Perseus	η	
"	*a*	1695	Draco	—	114,185	"	*a*	2555	Urs. Min.	11	
"	*a*	155	Cepheus	*2*	114?,185	"	*a*	2586	Libra	37	
"	*a*	1453	Gemini	σ	185	"	*a*	1244	Auriga	51	
"	*a*	4182	Cepheus	γ	185	"	*a*	1906	Leo Min.	47	
"	*a*	92	Androm.	δ	185	"	*a*	1972	Leo	—	
"	*a*	251	Perseus	υ	114,185	"	*a*	4259	Pisces	33	
"	*a*	3732	Cygnus	ζ	185	"	*a*	1030	Orion	ϕ^2	121
"	*a*	1629	Hydra	ζ	185	"	*a*	1500	Argo	12	20
"	*a*	2063	Corvus	ε	185	"	*a*	+80° 127	Cepheus	—	
"	*a*	775	Taurus	θ^1	185	"	*a*	+83° 287	Camelop.	—	
"	*a*	122	Pisces	62	185	"	*a*	+ 9° 1921	Cancer	—	
"	*a*	750	Taurus	δ	185	"	*a*	+58° 2314	Cepheus	—	122
"	*a*	560	Perseus	σ	185	"	*a*	+47° 460	Perseus	—	
"	*a*	2056	Draco	—	185	"	*a*	+24° 4473	Pegasus	—	
"	*a*	3836	Pegasus	ε	2,116,185	"	*a*	+ 0° 923	Orion	—	
"	*a*	3519	Vulpec.	19	2,117,185	"	*P*	576	Eridanus	ε	123
"	*a*	3460	Cygnus	η		*XV.*	*a*	1533	Cancer	β	
"	*a*	3316	Cygnus	κ		"	*a*	1698	Hydra	α	
"	*a*	3807	Cygnus	ρ	118	"	*a*	3418	Aquila	γ	
"	*a*	3654	Cygnus	T		"	*a*	862	Auriga	ι	
"	*a*	3708	Cygnus	—		"	*a*	2437	Urs. Min.	5	
"	*a*	2378	Hydra	π		"	*a*	2885	Hercules	π	
"	*a*	1734	Hydra	ι		XVI.	*a*	797	Taurus	α	
"	*a*	3005	Ophiuch.	ν		"	*a*	2500	Urs. Min.	β	32
"	*a*	2018	Urs. Maj.	χ		"	*a*	3466	Sagitta	γ	
"	*a*	1584	Urs. Maj.	π^2		"	*a*	3009	Draco	γ	
"	*a*	1941	Urs. Maj.	ψ	119,120	"	*a*	1685	Lynx	40	
"	*a*	1907	Urs. Maj.	46		"	*a*	1827	Urs. Maj.	μ	
"	*a*	4139	Aquarius	b^1		"	*a*	2343	Boötes	υ	
"	*a*	4093	Aquarius	c^2		"	*a*	1837	Hydra	μ	
"	*a*	401	Cassiop.	—		"	*a*	4031	Aquarius	τ	
"	*a*	2673	Corona	ε		"	*a*	4145	Aquarius	b^2	
"	*a*	3307	Draco	δ	119,120	"	*a*	1288	Camelop.	—	
"	*a*	119	Androm.	ζ		"	*a*	2636	Serpens	κ	
"	*a*	2595	Scorpius	*39*		"	*a*	2167	Com. Ber.	27	32
"	*a*	1394	Gemini	ι		"	*a*	375	Cetus	69	
"	*a*	1266	Gemini	30		"	*a*	653	Eridanus	γ	
"	*a*	3538	Capricor.	α^2		"	*a*	901	Lepus	ε	
"	*a*	4026	Pegasus	λ		"	*a*	1430	Gemini	υ	
"	*a*	2810	Hercules	η	119,120	"	*a*	1651	Urs. Maj.	σ^1	
"	*a*	3107	Hercules	109		"	*a*	1663	Argo	—	
"	*a*	464	Eridanus	η		"	*a*	3716	Cygnus	ξ	
"	*a*	2433	Boötes	ρ		"	*a*	*3717*	Cygnus	61	124
"	*a*	2488	Boötes	—		"	*a*	125	Pisces	δ	
"	*a*	4037	Cepheus	ι	119	"	*a*	315	Cetus	υ	
"	*a*	704	Cepheus	—		XVII.	*a*	185	Androm.	β	
"	*a*	3252	Sagittar.	o		"	*a*	1893	Hydra	ν	125
"	*a*	1302	Lynx	15		"	*a*	482	Cetus	α	

Group.	Div.	Cat. No.	Constellation.	Desig	Remarks.	Group.	Div.	Cat. No.	Constellation.	Desig.	Remarks.
XVII.	*a*	4040	Aquarius	λ	2	XVIII.	*a*	3649	Aquarius	3	34
"	*a*	2019	Virgo	ν		"	*a*	4217	Pegasus	ϕ	
"	*a*	3845	Cepheus	μ	126	"	*a*	2356	Draco	i	
"	*a*	1072	Auriga	υ		"	*a*	4120	Androm.	8	65
"	*a*	2201	Com. Ber.	36	32	"	*a*	2124	Draco	4	
"	*a*	1782	Leo	π		"	*a*	2802	Hercules	42	32
"	*a*	3357	Vulpec.	6		XIX.	*a*	489	Perseus	ρ	
"	*a*	3065	Hercules	A		"	*a*	533	Eridanus	τ^4	
"	*a*	30	Cetus	7		"	*a*	2510	Urs. Maj.	—	
"	*a*	3498	Draco	e		"	*a*	1360	Camelop.	—	
"	*a*	2563	Serpens	τ^1	65	"	*a*	1361	Gemini	51	20
"	*a*	3792	Pegasus	2		"	*a*	3210	Lyra	δ^2	
"	*a*	1988	Draco	λ	32?	*XIX.*	*a*	2879	Hercules	α	
"	*a*	1292	Cepheus	—		"	*a*	3224	Lyra	R	
"	*a*	2726	Ophiuch.	δ	127	"	*a*	2772	Hercules	g	129
"	*a*	855	Orion	5	20	"	*a*	+44° 3877	Cygnus	—	130
XVIII.	*a*	1091	Orion	α	128	XX.	*a*	370	Cetus	o	131
"	*a*	1160	Gemini	η		"	*a*	1752	Leo	R	132
"	*a*	4078	Pegasus	β	2	"	*a*	4234	Cassiop.	R	133
"	*a*	1102	Auriga	π		"	*a*		Orion	U	134
"	*a*	1952	Leo	72		"	*P*	3434	Cygnus	χ	135
"	*a*	1194	Gemini	μ	2	"	*P*	+67° 1291	Cepheus	T	136
"	*a*	821	Eridanus	54		XXI.	—	4198	Pisces	19	137
"	*a*	850	Orion	o^1		"	—	+38° 1539	Auriga	—	138
"	*a*	612	Camelop.	—	32	"	—	2164	Can. Ven.	—	139
"	*a*	2849	Hercules	*32*	65	"	—	1869	Hydra	U	140
"	*a*	2193	Virgo	δ		XXII.	—	1311	Can. Maj.	—	
"	*a*	2514	Scorpius	γ		"	—	+37° 3821	Cygnus	—	141
"	*a*	1638	Urs. Maj.	ρ		"	—	+36° 3987	Cygnus	—	142
"	*a*	4247	Pisces	30		"	—	+38° 4010	Cygnus	—	143

The stars whose spectra appear to be composite are enumerated in Table X. The first column gives the number in the Harvard Photometry, the second the constellation, and the third the Bayer letter. The fourth column gives the group to which the spectrum of the brighter star appears to belong. The spectrum of the fainter star appears to be almost always of the first type. The Orion lines are present in the case of ζ Aurigæ, and in the case of α Scorpii the spectrum of the companion is probably intermediate between the first and second types. A reference to the Remarks beginning on page 94 is contained in the fifth column.

TABLE X.

STARS OF COMPOSITE TYPE.

H. P.	Constellation.	Desig.	Group.	Remarks.	H. P.	Constellation.	Desig.	Group.	Remarks.
324	Andromeda . . .	γ	XV.	144	3739	Equuleus	α	XIII.	153
3362	Cygnus	β	XV.	145	650	Cepheus	—	XIII.	154
3528	Cygnus.	o^1	XV.	146	2764	Scorpius	α	XVII.	155
879	Auriga	ζ	XV.	147	4073	Andromeda . . .	o	V.	156
3421	Sagitta	δ	*XVII.*	148	1740	Leo	o	XII.	157
483	Perseus	γ	XIV.	149	2920	Ophiuchus	—	XII.	158
2467	Boötes	ε	XV.	150	*320*	Pisces	α	IX.	159
3554	Capricornus . . .	β	XIV.	151	3818	Capricornus . . .	γ	*XI.*	160
454	Perseus	τ	XIV.	152	1658	Ursa Major . . .	τ	XII.	161

Table XI. contains the stars of Orion type having bright lines. The first column gives the number from the Harvard Photometry, or for stars not contained in that catalogue, the zone and number in the Bonn Durchmusterung. The second column gives the constellation; the third, the letter or Flamsteed number designating the star. The fourth column gives the group and division to which the star in question would belong were its lines all dark. Where the agreement with any regular group of the series was not satisfactory, the group has been omitted, a statement of the phenomena being given in the Remarks. In the case of β Lyræ and υ Sagittarii the spectra of which are of composite type, the group and division has been given for both the primary and the secondary spectrum. The numbers of the Remarks are given in the fifth column.

TABLE XI.

STARS OF ORION TYPE HAVING BRIGHT LINES.

Cat. No.	Constellation.	Desig.	Group.	Rem.	Cat. No.	Constellation.	Desig.	Group.	Rem.
142	Cassiopeia .	γ	—	162	3747	Cygnus	υ	IV.*b*	169
269	Perseus . .	φ	—	163	*1220*	Monoceros . . .	11	IV.*b*	170
3960	Aquarius . .	π	—	164	2135	Draco	κ	V.*b*	171
3547	Cygnus . . .	P	—	165	578	Perseus	ψ	V.*b*	172
3193	Lyra	β	IV., VII.*c*	166	+23° 558	Taurus	—	V.*b*	173
3321	Sagittarius .	υ	VIII.*a*, IV.*b*	167	516	Camelopardalus	—	IV.*b*	174
1370	Canis Major	28	IV.*b*	168	1124	Orion	—	IV.*b*	175

REMARKS.

1. The lines of hydrogen are exceedingly wide.
2. This star approaches the following group.
3. This star combined with H. P. 1024 = θ Orionis. In both spectra the lines are exceedingly wide, especially those of hydrogen. The spectrum of the nebula is superposed, and appears as a number of separate images or irregular bright bands. Three of these correspond in position to the hydrogen lines Hβ, Hγ, and Hδ, while a fourth, which has great intensity, may be the hydrogen line Hλ, or may have shorter wave length. The hydrogen line Hε is probably represented by a trace of a bright band. An additional bright band having wave length greater than Hβ, and doubtless 5007.0, is present. Other indistinct bright bands are seen, and there may be dark lines also.
4. A distinct bright band borders the dark line 4649.2 on the side of shorter wave length. The Orion line 4096.9 is very strong in this star.
5. The only good photograph shows uncertain traces of a bright band bordering the dark line Hβ on the edge of shorter wave length. This, however, is unconfirmed, as the photographs taken with the eight-inch telescope did not show the bright band.
6. This star has been photographed only with one prism, but as the lines appear very sharp it is assumed to be of Division *a*.
7. The lines are exceedingly wide, and possibly double.
8. Plates very poor: the star is probably intermediate between this and the following group.
9. This star nearly resembles those of Group II., Division *b*, but is in several respects peculiar. In the great intensity of line 4120.5 and in the small intensity of line 4116.2 it is like stars of Group III. In the somewhat increased intensity of line 4387.8 and the slightly diminished intensity of 4089.2 it also approaches that group. It however approaches Group I. in the greater intensity of line 4685.4. See Remark 25. δ Scorpii resembles the star here described in some of its peculiarities, more especially in the small intensity of line 4116.2.
10. This star has been photographed only with one prism. It appears to be of Division *a*.
11. This star has been photographed only with one prism. It appears to be of Division *b*.
12. The image is very poor. The star may belong to this group.
13. In this star the line 3805.1 has unusually great intensity, and the lines 3982.8 and 3994.9 are somewhat stronger than in other stars of the group. In these respects the star resembles those of Division *c*, but in its remaining features it is not allied to that division.
14. This star appears to have the line K strong, and lines 3982.8 and 3994.9 somewhat conspicuous. The lines of hydrogen appear narrow in one of the photographs. The star may be of Division *c*. The plates, however, are poor.
15. The lines of this star, as seen in the photograph taken with four prisms, are somewhat hazy. This is probably due to imperfect focus.
16. The Orion line 3805.1 is stronger than in the typical star.
17. In the best photograph taken with four prisms, the lines, though narrow, appear hazy on the edge of greater wave length. This may indicate the presence of the lines of a companion star. See Remark 18. The remaining plates are either too poor or of insufficient dispersion to prove or disprove the presence of the companion lines. The star is assumed to be of Division *a*.
18. The spectrum of this star has two phases. At times it is of the ordinary type of Division *b*, having wide lines uniformly hazy, but well defined on their edges. At other times the lines are narrower, but hazy on the edge of shorter wave length. In the stronger lines of the spectrum the ragged border is replaced by distinct companion lines. These are probably due to the presence of the accompanying star, discovered by Vogel, the motions of which may give rise to the above described change in the spectrum. See Remark 19.
19. The hydrogen and Orion lines of this star appear to have companion lines similar to those found in α Virginis. See Remark 18. They occupy, as in that star, the position of shorter wave length. These may be due to the known companion. It has not been determined whether the spectrum changes like that of α Virginis.
20. Plates poor. The star probably belongs to this group.
21. The spectrum of the nebula is superposed. See Remark 3.
22. This star is probably of Division *a*.
23. This star is probably of Division *b*.
24. The plates are poor. The star probably belongs either to this group or to Group IV. A line having wave length 4416 approximately is stronger than in other stars of the group. This is probably due in part to combination with the Orion line 4437.9, which does not usually appear in stars of this group when photographed with one prism.
25. The peculiarities of this star can nearly be explained by supposing a combination of the spectra of Group III., Division *a*, and Group II., Division *b*. All the principal lines of Group III., Division *a*, are present, and they have the usual intensity, except in the following cases: lines 4069.4, 4072.0, 4089.2, 4649.2, and 4685.4 have the same intensity as in Group II., Division *b*, and the lines 4026.4, 4471.8, and 4712.8 are a little more intense than in either of the groups mentioned. The spectrum cannot be classed as of Division *a*, since the hydrogen lines and the principal Orion lines appear wide. Yet it differs from all ordinary spectra of Division *b* in having the faint lines of its group clearly present. In the plate taken with four prisms, the lines appeared double; the plate was, however, not very good. The star resembles in many respects those having composite spectra, but cannot be clearly classed as such because the line 4116.2, strong in stars of Group II., appears only as a faint line. In this last peculiarity the star resembles H. P. 1043 of Group II. See Remark 9.
26. The intensity of the Orion line 4649.2 is somewhat greater than in the typical star, and approaches that shown in the preceding group.
27. In the intensity of the lines between Hζ and Hη this star

agrees with those of Group V. Thus the Orion line 3863.2 is shown even under the dispersion of one prism, and 3856.2 is the strongest line between Hζ and Hη.

28. This star has been photographed only with one prism. It may belong to Division *b*.
29. In the photograph taken with two prisms the lines appear slightly hazy. It is uncertain whether this is due to photographic defect, or is inherent in the nature of the spectrum. In the latter case, the star should be classed in Division *ab*.
30. This star may belong to the following group..
31. Plates poor. The star is either of this or the following group.
32. This star approaches the preceding group.
33. This star approaches the following group in the faintness of its Orion lines, yet has fewer solar lines than the typical star of the present group. It is also slightly peculiar in the relative intensity of its solar lines.
34. This star may belong to the preceding group.
35. The Orion lines are stronger and the metallic lines are weaker than in η Leonis, the typical star of Group VII., Division *c*, and the intensity of the hydrogen lines is intermediate between that found in Group VI., Division *c*, and Group VII., Division *c*. The Orion lines present are 4026.4, 4471.8, 4387.8, and 4267.4.
36. The star resembles H. P. 551. See Remark 35.
37. See Remark 35. The Orion lines present are 4026.4, 4471.8, 4387.8, 4009.5, 3819.2, 4267.4.
38. Plates very poor. The star appears to be of Division *c*, and probably lies between Groups VI. and VII. It is, however, uncertain to what group it belongs.
39. The lines of this star are not so narrow and sharply defined as those of the other typical star of Division *a* in this group.
40. The intensity of the hydrogen lines is perhaps a little greater than in α Canis Majoris. The remaining lines are sharper and more clearly defined than in that star, but are in general less intense, while a few of the faintest lines seen in that star are lost. The Orion line 4471.8, absent in α Canis Majoris, is present. The only remaining differences observed are that the solar line 4067.0, which appears with moderate intensity in α Canis Majoris, is here seen only as a faint trace, and that the solar line 4247.8, absent in that star, is here well defined.
41. The lines are perhaps a little hazy.
42. The Orion line 4026.4, and a trace of 4471.8, are present.
43. The Orion line 4026.4 is present.
44. This star differs from other stars of Division *a* in the greater intensity shown in the lines 4128.5 and 4131.4. It also has fewer solar lines, and the relative intensity of those present is slightly peculiar. The star in some degree resembles θ Aurigæ and 12 Canum Venaticorum of Group VIII., but differs from them in not having the line K weaker than is normal for the group. The lines of the spectrum may be very slightly hazy.
45. This star is peculiar. The Orion lines 4026.4 and 4471.8 are present, yet the general intensity of the solar lines approaches that found in the following group. A few of the solar lines are peculiar in intensity. The line K has the same intensity as in other stars of Group VII., Division *a*.
46. The relative intensity of the solar lines differs slightly from that shown in the typical star.
47. The lines are exceedingly wide.
48. A trace of the Orion line 4026.4 is probably present.
49. In the intensity of the solar lines, the star slightly approaches the following group.
50. In one photograph the line K appeared double. The best plates, however, give the line K single, and the apparent doubling is probably due to defective focus.
51. The lines are but little wider than in stars of Division *a*.
52. In several photographs of this star, the line K appeared indistinctly double. The duplicity has, however, not been satisfactorily confirmed.
53. In the intensity of the line K and of the solar lines the star approaches the following group.
54. The star is probably of this group and division.
55. The lines are probably slightly widened.
56. The periodic doubling of the lines of this star will be discussed in another publication of the Observatory. When the lines are single, the spectrum is of Division *a*. Before doubling, the lines widen, and the spectrum assumes the character of typical stars belonging to Division *b*.
57. In two of the photographs of this star the lines appear slightly hazy. This may be due to poor definition in the photograph.
58. The solar lines shown are few in number for this group. This may perhaps be due to the poor quality of the plate, as the line K is as strong as in typical stars of the group.
59. In the intensity of the solar lines this star resembles those of the following group. The width of the line K, however, as seen under the dispersion of one prism, is normal for this group. In one photograph the lines appear slightly hazy. This is perhaps due to poor definition, as in the remaining plates the lines are sharply defined.
60. In the intensity of line K this star approaches the following group.
61. In the narrowness of line K this star approaches the preceding group. The solar lines, however, are nearly the same as in typical stars of Group VIII.
62. The violet end of the spectrum of this star appears on a plate showing the spectrum of η Pegasi. The star is probably of Group VIII., but approaching Group VII.
63. The plate is poor. The star is probably of Group VIII., Division *a*, but may belong to Group VII., Division *b*.
64. The line K appeared double in one of the photographs, but this duplicity has not been confirmed.
65. Plates poor. The star belongs either to this or to the preceding group.
66. In its general aspect this star resembles those of Group VIII., which approach Group VII. A few of its faint lines, however, are peculiar, some in intensity and others in wave length. The line K is even weaker than in stars of the preceding group. In this respect the star resembles those having composite spectra.
67. This star is peculiar in the intensity and wave length of some of its lines. It may for convenience be classed with stars of Group VIII., approaching Group VII., but in the details of its spectrum it is not like those of either group. The hydrogen lines are the same as in the above men-

tioned groups, and the majority of the remaining lines are those of Group VIII., Division *a*. Many of the solar lines which are present in that group, however, are absent, especially in the region having wave length shorter than 4101.8, where the lines are few and weak. On the other hand, some well marked lines appear, which are either faint or absent in normal stars of the group. The Orion lines 4026.4, 4471.8, and 4267.4 are present. The line K is rather fainter than in stars of Group VII. The lines are narrow, as in Division *a*.

68. This star resembles α Andromedæ, (see Remark 67,) so far as can be ascertained from plates taken with two prisms.

69. This star most nearly resembles those of Group VIII., Division *a*. It has, however, marked peculiarities. Thus, the line K is extremely faint, and the lines 4131.4 and 4128.5 have greater intensity than in any other stars except those of Division *c* in Group VIII. Some of the fainter lines appear to be peculiar in wave length, while others differ in intensity from the corresponding lines of the stars in Division *a*. In the weakness of the line K alluded to, this star resembles those of composite type, and its peculiarities may perhaps be due to its known duplicity. If, however, in the companion star the line K is so faint, it is difficult to explain the absence of the Orion lines.

70. This star closely resembles 12 Canum Venaticorum. See Remark 69. It differs from that star only in the altered intensity of several faint lines, and in the presence of several others not seen in 12 Canum Venaticorum.

71. The spectrum of this star resembles the spectra of 12 Canum Venaticorum and θ Aurigæ. See Remarks 69, 70. The photographs are somewhat faint, and as they have not been taken under the greatest dispersion a more detailed comparison with those stars cannot be made. Some differences probably exist among the faint lines.

72. In the general intensity of the solar lines the star lies between Group VIII., Division *a*, and Group VII., Division *a*. The line K, however, is fainter even than in stars of the latter group. In this respect the star resembles those having composite spectra, and its peculiarities may be due to its duplicity. The lines of hydrogen are somewhat wider than in stars belonging to Division *a*, yet the remaining lines do not show the widening seen in stars belonging to Division *b*. A slight variation is shown in the relative intensity of the solar lines, and this, together with the weakness of the line K alluded to, causes the star to resemble in some degree θ Aurigæ and 12 Canum Venaticorum.

73. The photographs show a slight variation in the width of the line K and the solar lines. This is probably due to the difference in density of the image, as shown in the several photographs.

74. The photographs of this star show fewer solar lines than those of the other stars with which this is classed. The star may be in this respect peculiar, or may belong to Division *b*. As, however, only one of the photographs is good, the absence of the fainter lines may result simply from the quality of the plate.

75. In the photograph taken with the greatest dispersion, the solar lines appear with an intensity somewhat faint for the group. As this does not appear in the plates taken with fewer prisms, it may be due to the quality of the plate.

76. The lines are probably as narrow as in stars of Division *a*. If any slight widening exists, it is not enough to appear in the photographs taken with two prisms.

77. The lines of hydrogen and the line K appear somewhat narrower than in the remaining stars of this group. The line K has a trace of a bright border on the edge of shorter wave length.

78. The star may in some degree resemble those of Division *ac*.

79. This star is very peculiar in the relative intensity of its solar lines.

80. The star approaches, and may belong to, the preceding group.

81. This star is probably of Division *a* or Division *b*.

82. In the only photograph of this star which has been taken with four prisms the lines of hydrogen and those of calcium appear narrower than in typical stars of Division *a*. Yet the star approaches neither Division *c* nor the following group. These peculiarities are much less apparent in the photograph of smaller dispersion, and are therefore at present unconfirmed. The solar lines present are the same as in α Canis Minoris, except that 4006.9 does not appear. Their relative intensity is the same as in that star.

83. The band K is somewhat wider than in the typical star.

84. The band at 4307 is somewhat strong for a star of this group.

85. The band at 4307 and the line at 4326.0 are not clearly shown. The image, however, is dense and ill defined.

86. The line 4326.0 does not appear in the photograph, and the solar lines in general seem somewhat faint. The plate, however, is poor.

87. The spectra of 40 and 41 Draconis can readily be separated. They are indistinct in the photographs taken, but appear to be nearly or quite similar, and to belong either to this or the following group. The hydrogen lines Hβ, Hγ, and Hδ, and the band at 4307, can be distinctly seen in each of the spectra.

88. The lines of this star appear uncommonly narrow and weak. As there is but one photograph, this aspect may be accidental.

89. This star is probably intermediate between ε Aurigæ of Group XII., Division *c*, and δ Canis Majoris of Group XIII., Division *c*. It was at first classed with stars of Division *ac*, intermediate between the groups, but its resemblance to such stars is not satisfactory. In the intensity of its metallic lines it resembles δ Canis Majoris, while in its comparatively narrow K band it is allied to ε Aurigæ. Its lines of hydrogen are intermediate in intensity between those of the two stars. As in stars of Group XIII., Division *c*, when photographed with a single prism, the apparent intensity of the lines Hβ and Hγ is greater than that of the remaining lines of hydrogen, owing to the combination of Hβ and Hγ with adjacent strong lines. The bands H and K of calcium are nearly equal, and the latter does not differ greatly in intensity from the band K of ε Aurigæ.

90. The spectrum of this double star has a peculiar hazy appearance. The line K, however, does not appear nar-

row or obscure, as in composite spectra combining the first and second types.

91. The lines of hydrogen have as great intensity as in Group XII. The band at 4307 is strong.

92. The intensity of the lines of this star agrees with that shown in the photograph of the solar spectrum, except in the following details: lines 4171.2, 4195.6, 4200.9, and 4783.6 are nearly or quite invisible; lines 4012.6, 4067.0, 4077.9, 4090.2, 4104.3, 4196.8, 4205.3, 4321.0, 4401.6, 4408.5, 4450.6, 4508.5, 4515.4, 4629.9, 4698.8, and 4848.4 are stronger than in the Sun; and lines 4076.8, 4206.9, 4318.9, 4323.7, 4405.0, and 4703.1 are weaker than in the Sun. Those among the last two classes enumerated which differ markedly from the solar intensity are 4077.9, 4196.8, 4205.3, and 4698.8 of the first class, and 4076.8, 4323.7, and 4703.1 of the second class. The comparison with solar intensities was, however, difficult to make with accuracy, owing partly to the fact that the solar spectrum, unlike that of the star, had been obtained by the use of a slit spectroscope, and partly also to the fact that the lines of α Aurigæ are slightly wide and hazy.

93. The spectrum of this star, unlike that of α Aurigæ, has perfectly clear and narrow lines. It agrees with that of the Sun, except in the following details: lines 4014.7, 4171.2, and 4204.2 are absent; lines 4012.6, 4035.8, 4048.9 to 4049.7, 4156.7, 4161.7, 4205.3, 4258.7, 4321.0, 4401.6, 4408.5 ?, 4450.6?, 4508.5 ?, 4513.0, 4629.9 ?, 4698.8, and 4848.4 are stronger than in the Sun; lines 4034.6, 4405.0, and 4703.1 are weaker than in the Sun. Those exhibiting marked differences from the solar intensity are 4321.0 and 4513.0.

94. The spectrum is relatively faint in the region having wave length shorter than 3889.0. In this respect the star approaches the following group.

95. The line 4077.9 is somewhat stronger than in α Aurigæ.

96. The general absorption is great for wave lengths less than 3889.0, and begins to be visible in the region between wave lengths 4144 and 4216. In these respects, as well as in the general intensity of its lines, the star approaches the following group. The intensity of the hydrogen lines is, however, about the same as in the present group. The line 4077.9 appears stronger than in α Aurigæ. This is, however, very likely due to a greater intensity of the line 4076.8, which, under the dispersion used, combines with 4077.9. The former line is weaker in α Aurigæ than in the Sun.

97. General absorption is somewhat strong in the region having wave length shorter than 3889.0, and is faintly visible between 4144 and 4216. The line 4077.9 is strong. The star slightly approaches the following group.

98. The lines Hβ, Hγ, Hδ, and Hε of the star H. P. 3982 appear superposed on the spectrum of H. P. 3981.

99. This star resembles ζ Capricorni of Group XV., but is less peculiar. See Remark 111. In the intensity of its hydrogen lines it agrees with stars of Group XIV., Division *a*, and in the relative intensity of its solar lines it nearly resembles them. In the aggregate intensity, however, of the solar lines, as also in the brightness of the bands 4315 to 4368, 4470 to 4525, and 4614 to 4648, and in the amount of absorption in the region of wave length shorter than 3889.0, it is like the star α Cassiopeiæ of Group XV. The width of the calcium bands also, is at least as great as in Group XV. The amount of absorption in the region between 4144 and 4216 is intermediate between that shown in Group XIV. and in Group XV. The solar lines 4077.9, 4374.7 to 4376.1, 4654.8 to 4657.0, 4663.7, and 4668.0 are somewhat stronger than in stars of Group XIV., and other differences probably exist.

100. This star is nearly like ε Leonis, (see Remark 90,) but the amount of general absorption, both in the region between 4144 and 4216 and in that having wave length shorter than 3889.0 equals or exceeds that shown in stars of Group XV. The band containing the solar lines 4663.7 and 4668.0, seen as one line under this dispersion, is stronger than in ε Leonis. The calcium lines are not well shown, but are probably the same as in the above mentioned star.

101. This star resembles α Cassiopeiæ more nearly than α Boötis in the amount of general absorption in the region having shorter wave length than 4300, and in the intensity between lines 4215.7 and 4227.0.

102. The band containing the solar lines 4196.8, 4198.5, 4202.2, and 4205.3, irresolvable under this dispersion, is stronger than in other stars of this group.

103. The solar line 4323.7 is stronger than in typical stars of Groups XIV. and XV. The line 4337.6 has probably also a greater intensity.

104. This star closely approaches Group XV.

105. This star closely approaches Group XIV.

106. The hydrogen lines are as strong as in Group XIV. The line Hζ, indeed, appears in the only good photograph to be even stronger than in stars of that group.

107. The spectra of the components of the double star are inseparable.

108. The spectrum of the faint star +29° 1823, which is of the first type, is superposed.

109. The degree of general absorption shown in the violet region is as great as in stars of Group XV.

110. In one of the photographs the line K appears weak. The plates are very poor.

111. The spectrum of this star is very peculiar. It perhaps most nearly resembles that of stars lying between Groups XIV. and XV., but the general absorption in the region having shorter wave length than 4307 is as great as in α Cassiopeiæ of Group XV., while the hydrogen spectrum is as strong as in Group XIV. The solar lines 4076.8 to 4077.9, 4215.7, 4668.0, and 4670.0 are stronger than in stars of either of the above groups, while 4405.0 is weak or absent. A line of great intensity is seen, which probably includes the solar lines 4554.2 and 4556.0. Other peculiarities are shown among the fine lines of the spectrum.

112. The line 4227.0 appears somewhat stronger than in α Boötis.

113. The amount of absorption in the violet is probably a little greater than in α Cassiopeiæ.

114. The line 4227.0 is a little stronger than in α Cassiopeiæ.

115. The star –8° 243, which is in the same right ascension, is superposed. This star is of the first type, and its superposition narrows the line K of the principal star. This effect, though slight, is interesting in its bearing on the theory of composite spectra.

116. The hydrogen lines appear as strong as in stars lying between Groups XIV. and XV.

117. The line or band containing the hydrogen line Hγ and the line 4337.6, irresolvable under this dispersion, is as strong as in the preceding group. The hydrogen lines Hβ and Hδ are not shown, as the plates are poor. A faint star of the first type is superposed.

118. In the intensity of the hydrogen lines the star approaches the preceding group.

119. The amount of general absorption is probably intermediate between that found in α Boötis and that found in α Cassiopeiæ.

120. The space between the lines 4215.7 and 4227.0 appears bright as in α Cassiopeiæ.

121. The line 4227.0 has relatively great intensity.

122. Plates poor. The star probably approaches, and may belong to, the following group.

123. The star is peculiar in the intensity of some of the solar lines in the region between 4227.0 and the line H. The line K is as narrow as in stars of Group XI.; but as the hydrogen lines are not stronger than in stars of Group XV., this star cannot be classed with those having composite spectra.

124. The spectrum appears as though a faint star of the first type were superposed. This may perhaps be due to the adjacent star.

125. On a plate of fair quality, taken under the dispersion of two prisms, the star was classed in Group XV. The photograph taken with four prisms, which was of good quality, showed it to be certainly of Group XVII. Both plates agreed in right ascension and declination, and the plate taken with two prisms was identified also by means of additional stars in the field. These were too faint to appear in the plate taken with four prisms.

126. The line 4227.0 is no stronger than in stars of Group XV., and the star is otherwise peculiar.

127. The absorption bands characteristic of third type stars are not as well defined as in most stars of this group. In this respect the star approaches the preceding group.

128. The lines of hydrogen and the line 4227.0 have an intensity similar to that seen in the preceding group. A similar increase in the intensity of the hydrogen lines and diminution in the width of 4227.0 are seen in stars having composite spectra.

129. The brightness is nearly uniform from 3970 to 4762. In this respect the star agrees with those of Group XX., but the lines of hydrogen are not bright.

130. The distribution of light is probably the same as in g Herculis. See Remark 129. The photographs, however, are too faint to show this with certainty. The absorption band having its edge of shorter wave length at 4586 is well shown.

131. The hydrogen lines Hγ, Hδ, Hζ, Hη, Hθ, Hι, Hκ, Hλ, Hμ, and Hν are bright, the last line being stronger than the three preceding. In some photographs the line Hβ is seen as a very narrow bright line. In other good plates it is not seen.

132. The hydrogen lines Hγ, Hδ, Hζ, Hη, Hθ, and Hι are bright.

133. The hydrogen lines Hγ, Hδ, Hζ, Hη, Hθ, and Hι are bright.

134. The hydrogen lines Hγ and Hδ are bright. The other hydrogen lines are not seen, owing to the faintness of the image.

135. The hydrogen lines Hβ, Hγ, Hδ, Hζ, Hη, Hθ, Hι, and perhaps Hκ, are bright. The line Hβ is less intense than Hγ. An additional bright line is seen at about 3900. This is faintly visible in ο Ceti. The distribution of light differs from that of the typical star of the group. See page 46.

136. The hydrogen lines Hγ, Hδ, Hζ, and perhaps Hη, are bright. The star resembles χ Cygni, except that the line Hβ is not bright. This may be due to the faintness of the image. The distribution of light differs from that of the typical star of the group. See page 46.

137. The photographs show clearly the two absorption bands characteristic of the photographic spectrum of stars of the fourth type. The band of shorter wave length is well defined, and a bright border is faintly seen on either edge. The band of greater wave length is well defined on the edge of greater wave length, and fades gradually in the other direction. The photograph taken by means of erythrosin shows the strong dark line near the region of the sodium line D, which is characteristic of stars of the fourth type. Eight or nine fainter lines lying between 5900 and the absorption band of greatest wave length are also present. Traces of dark lines are seen elsewhere in the spectrum, the two principal lines being those on either side of the absorption band of shortest wave length. The photographic spectrum extends from about 4307 to beyond 5900.

138. This star resembles H. P. 4198. See Remark 137. It shows both absorption bands and the strong line in the yellow near the region of D. The image is too faint to show whether the remaining lines seen in the yellow of H. P. 4198 are present. Indistinct traces of four or five lines appear in the region having shorter wave length than 4860. The absorption band in this region is well defined on the edge of greater wave length, where it is bordered by a bright space having about half the width of the band. The edge of shorter wave length of the absorption band is more indistinct. The other absorption band is not well defined on either edge. The image is somewhat poor and faint. The spectrum extends from about 4580 to 5900, or beyond.

139. The absorption band having its edge of greater wave length at about 4861 is well defined, has a bright border at this wave length, and fades gradually toward the violet. As the star has not been photographed on plates stained with erythrosin, the region of the second band and of the line D are not shown. The photograph is too poor to show definite lines.

140. This star closely resembles +38° 1539, No. 19 of Dunér's second list, but, as the photograph is clearer, more lines are shown. In addition to the strong line in the yellow, five or six other lines appear which agree with the principal lines of 19 Piscium. The stars H. P. 1869, H. P. 4198, +38° 1539, and H. P. 2164 are thus in all probability closely similar.

141. The image is faint. The bright bands of H. P. 1311, at wave lengths 4059, 4102, and 4688, with traces of others, are seen superposed on the faint continuous spectrum.

142. The image is faint and ill defined. The bright bands of H. P. 1311 at wave lengths 4059, 4102, 4614, and 4688, and possibly others, are seen superposed on the faint continuous spectrum.

143. The image is very faint and ill defined. Of the bright bands of H. P. 1311, that at wave length 4688 only can be clearly seen on the continuous spectrum.

144. The spectrum of this double star presents the combination of a normal spectrum of Group XV., like that of α Cassiopeiæ, with one of a fainter first type star. By the superposition of the latter, the K band of the second type star is nearly obliterated, and only the narrow K line of the first type star appears. The ultra-violet hydrogen lines Hζ, Hη, Hθ, and Hι, belonging to the first type star, are well shown. In this region of the ultra-violet, the spectrum of the first type star predominates, obliterating many of the fainter lines of the star of the second type. In the region between 3970 and 4860 the spectrum of the second type nearly obliterates the other, the presence of which is detected only by a slightly increased intensity in the hydrogen lines Hβ, Hγ, and Hδ. The spectra are nearly inseparable, the difference in right ascension being little, and that in declination still less. The photographic image, however, of the first type star, on one edge extends beyond that of the second type star, and the former can thus be shown to have the greater right ascension. The peculiarities above described are interesting in their bearing on the general question of composite spectra. The narrow K line is slightly hazy, as in stars belonging to Division *b*.

145. The spectrum of the star H. P. 3368, which is of the first type, or perhaps of the later Orion type, is superposed on H. P. 3362, but is readily separable from it, owing to its difference in right ascension and declination. When the images are coincident, that of the first type star predominates in the ultra-violet, that of the second type star in the blue and violet. The strong hydrogen lines Hζ, Hη, Hθ, Hι, Hκ, and Hλ are well shown, while Hβ, Hγ, and Hδ are nearly concealed. The above mentioned details are of interest as bearing on the question of composite spectra; the important fact, however, is that the spectrum of H. P. 3362 has itself a composite character. It is in general like that of α Cassiopeiæ, of Group XV., but has the strong hydrogen lines and the weak and narrow K line of a star of the first type. The hydrogen lines Hδ, Hζ, Hη, and Hθ are conspicuous, and Hβ and Hγ are stronger than in normal stars of Group XV. The compound band H is of course well marked. In the ultra-violet the fainter lines characteristic of stars of Group XV. are obliterated. As the appearances here described are equally well shown in those portions of the image where H. P. 3363 is not superposed, they are certainly not due to that star. They could be explained on the supposition that H. P. 3362 is itself double, one component being a star of the second type belonging to Group XV., the other a star of the first type approaching the second type.

146. The spectrum of this double star resembles that of γ Andromedæ, which combines the features of Group XV. with those of the first type. In the present case, however, the images are coincident throughout. The hydrogen lines Hδ, Hε, Hζ, and Hη appear as in a first type star, and the lines Hβ and Hγ are stronger than in normal stars of Group XV. The band K is reduced to an inconspicuous haze, and in the violet region many of the fainter lines characteristic of second type stars are lost.

147. This star is one of the most beautiful examples of composite spectra found among stars not known to be double. It resembles 31 Cygni, but shows still more strikingly the features of the first type. The spectrum predominant in the blue is of Group XV., agreeing with that of α Boötis, except in the hydrogen lines Hβ and Hγ, which are far too strong for the group. The spectrum predominant in the violet and ultra-violet appears to be of the Orion type, and may probably be classed in Group V. The hydrogen lines Hε, Hζ, Hη, Hθ, Hι, Hκ, Hλ, and Hν have the great intensity characteristic of stars of the later Orion type or earlier first type, while that of the line Hδ is but little reduced. The band K appears merely as an inconspicuous haze, or in the best plate as a more distinct but narrow line. In the region having wave length shorter than 4000, solar lines are few as compared with the number found in normal stars of the second type. This is more noticeable in the photograph taken with one prism. The Orion line 3819.2 is well shown, and excepting those of hydrogen it is the only well marked line in that region. The Orion line 4026.4 is also present.

148. The spectrum of this star presents the most marked contrast shown among the composite spectra studied in this investigation. Here the spectrum of a star of the third type intermediate between Groups XVII. and XVIII., and nearly resembling that of α Orionis, is combined with that of a star of the first type. The absorption bands characteristic of the third type may be seen in the region between 4762 and 5900, while in the violet and ultra-violet the hydrogen lines Hδ, Hε, Hζ, Hη, and Hθ are as strongly marked as in the first type. Hβ, and Hγ are somewhat strong, but not of corresponding intensity. The line K, when appearing at all in the photographs, is seen as a somewhat wide and indefinite haze.

149. This star combines a spectrum of Group XIV., that is, resembling that of the Sun, with a spectrum of the first type, belonging perhaps to Group IX. The hydrogen lines Hβ, Hγ, Hδ, Hζ, Hη, Hθ, Hι, Hκ, Hλ, and Hμ are well shown. The line K appears as a rather narrow line of moderate intensity, and somewhat hazy on the edge of shorter wave length. The compound band Hε and H is the same as in Group XIV. Many of the lines in the ultra-violet region characteristic of second type stars are present. The star of the first type probably approaches the second type.

150. This double star combines a spectrum of Group XV., like that of α Cassiopeiæ, with one of the first type approaching the second. The hydrogen lines Hβ, Hγ, Hδ, Hζ, Hη, Hθ, Hι, Hκ, Hλ, and Hμ are seen, together with ultra-violet lines characteristic of second type stars. These hydrogen lines, however, are only of moderate intensity, as in stars intermediate between the first and second types. The line K is narrow but clear. It is of equal intensity with the lines of hydrogen, yet this intensity is scarcely two tenths that of the band H, which is normal for a second type star. This wide difference in the intensities of the lines H and K is difficult to explain, inasmuch as the moderate width of the hydrogen lines requires the assumption that the companion star approaches the second type. It is, however, not improb-

able that the apparent width of the hydrogen lines is diminished and that of the K line increased by superposition on the spectrum of the second type, or it may be that the star of the first type has the narrow lines of Division *c*.

151. The spectrum of this star closely resembles that of the double star ε Boötis. See Remark 150. In the present star, however, the principal component is of Group XIV., while the hydrogen lines are more pronounced and the line K weaker than in the above mentioned star. The secondary spectrum may be of Group IX. or Group VIII. The hydrogen lines from Hβ to Hλ inclusive are seen.

152. The spectrum is nearly like that of α Aurigæ, of Group XIV., but the intensity of the hydrogen lines is too great for this group, and the line K has not more than half the width of H. If this spectrum, which thus is evidently composite, is assumed to be that of a double star, the component of the earlier type should be intermediate between the first and second types. It is difficult to say whether it should be classed in Group X., XI., or XII., since it is uncertain how much the apparent width of the hydrogen lines would be reduced by superposition on the spectrum of the second type.

153. The spectrum of this star combines the features of Group XIII. with those of stars intermediate between the first and second types. The hydrogen lines Hβ, Hγ, Hδ, Hζ, Hη, and Hθ are well shown, and a trace of Hι appears. The line K is equal in width to Hζ, but has only half the width of H. The assumed companion star should probably be of Group X. or XI.

154. This double star shows a spectrum of Group XIII. combined with one of a first type star which may belong to Group IX. or X. The line K has about the same width as the lines of hydrogen, but only half that of the line H.

155. The spectrum is substantially that of a star of Group XVII. approaching Group XVIII. There are, however, indications of a faint superposed spectrum intermediate between the first and second types, and belonging perhaps to Group XI. or XII. The ultra-violet hydrogen lines Hζ, Hη, and Hθ are shown, and Hβ, Hγ, and Hδ are too strong for a star of the third type. The band K is hazy, and has a central line of clearer definition. These appearances are probably due to the faint companion. Some excellent photographs of the region between 4860 and 5900 have been obtained by means of plates stained with erythrosin. These have the dispersion of four prisms, and show all the lines found in α Orionis in this region, and enumerated in Table VI. These lines have, with a few slight exceptions, about the same intensity as in α Orionis. As, however, the star is a little earlier in the series, the absorption bands characteristic of the third type are not so well developed as in α Orionis, and the dark lines covered by them are therefore more clearly shown.

156. This star is very peculiar. It combines the spectrum of a star belonging to Division *c* of Group VII., approaching Group VIII., with that of a star of the Orion type, belonging to Group V. In plates taken with two prisms, only the spectrum of the Orion type appears, but in those taken with one prism the lines of Group VII., Division *c*, approaching Group VIII., Division *c*, come into prominence, and have the same relative intensity as in α Cygni. The loss of these well marked lines when more prisms are used appears to show that they belong to the spectrum of a fainter star. This would furnish an exception to the nearly universal rule that in binaries the fainter star is of the earlier type. As all lines appearing in the plates taken with two prisms are hazy, the spectrum of the brighter star must be of Division *b*, unless its lines are affected by the otherwise invisible spectrum of the fainter star.

157. This star appears to combine a spectrum of Group XII. with one of earlier type, belonging probably to Group X. The line K has only seven tenths the width of the compound line Hε and H, yet the band 4307, though faint, is visible in the plates taken with one prism.

158. This star combines a spectrum of Group XII. or XIII. with the strong hydrogen lines of a star of the first type. The line K is very weak and hazy.

159. This double star appears to combine a spectrum of Group IX. with one of earlier type, which may be Group VII., Division *b*. The number and intensity of the solar lines is the same as in Group IX., while the line K is faint and hazy, having the width and intensity shown in stars of Group VII., Division *b*. The hydrogen lines are wide, as in stars of Division *b*. No Orion lines can be detected.

160. This star appears to have a composite spectrum. In the number and intensity of its solar lines it lies between Groups XI. and XII., while the intensity of the line K and the hydrogen lines would place it in Group X. The line 4077.9 has an intensity unusually great even for a star of Group XII. See Remark 161.

161. This star probably has a composite spectrum, and nearly resembles γ Capricorni. See Remark 160. From the number and intensity of its solar lines it should be classed in Group XII. The width of the lines K and H, however, and the intensity of the hydrogen spectrum, would place it in Group X. The band 4307 is weak for a star of Group XII., and appears to be the same as in stars intermediate between that and the preceding group. The portion of the spectrum immediately bordering the line K on the edge of shorter wave length is brighter than in stars of the regular groups, and resembles a bright band. The star has been photographed only with one prism.

162. This star is one of the most interesting among those of the Orion type having bright lines. Its most important peculiarity is shown in the double reversal of its hydrogen lines. Each of these, typically considered, consists of a bright band of moderate width superposed on a very wide and hazy dark band, and having superposed upon itself centrally a very fine dark line. The intensity of the bright band is great in the line Hβ, and diminishes with each succeeding hydrogen line of shorter wave length. In the line Hε the bright band is nearly neutral, or but little brighter than the background of the spectrum, while in the lines beyond Hζ no bright lines are seen. The underlying dark bands and the fine central dark lines become more conspicuous as the bright bands decrease. Thus, while in the line Hβ these dark elements are barely visible, in the lines beyond Hζ they compose the entire line. The width of the underlying dark bands is greater than is seen among the stars of Division *b*, in which the lines are

widest. It should be noted that the hydrogen line Hκ is comparatively narrow, and appears to be displaced in the direction of greater wave length. This may be due to the disappearance of the more refrangible half of the dark band. Compare Remark 163. The hydrogen lines beyond Hκ, if present, are indistinct; traces are seen which may be the lines Hν and Hξ. Other bright bands are seen in this spectrum besides those of hydrogen, the most important of these being in the region between 4860 and 5900. The strongest of them are the Orion line 5023 and one having somewhat greater wave length. Four fainter lines follow, having still greater wave length. Other bright regions appear elsewhere in the spectrum which are not well defined bright bands, like those previously described, but have rather the nature of bright spaces between dark lines, or of bright borders to these lines. Among these may be noted that between the Orion lines 4576.5 and 4591.6 and one near 4531.4 on the side of shorter wave length, and many others are more or less distinctly visible elsewhere in the spectrum. These, however, vary greatly under different dispersions, an increase of dispersion frequently rendering the wider bands invisible, and bringing new and narrower bands into prominence. The entire region from the Orion line 4154.7 to line 3927.1 appears brighter than the rest of the spectrum, this brightness not being, however, homogeneous, but greater in the spaces between certain of the dark lines. This wide region of increased brilliancy has also been noticed in the normal stars of Groups I. and II. It does not appear in the later Orion groups, nor elsewhere in the series. It may be of interest to note that in γ Cassiopeiæ the strongest of the Orion lines are without distinct bright borders. All the dark lines in this spectrum appear as wide and hazy bands. This system of dark lines is more closely related to those of Group II. than to the spectra of any other group. A number of the more prominent lines of Group II. are present, those clearly shown being 3819.2, 3867.6, 3912.2, 3927.1, 3994.9, 4009.5, 4026.4, 4069.4, 4072.0, 4089.2, 4116.2, 4120.5, 4144.0, 4254.1, 4267.4, 4285.1, 4387.8, 4471.8, 4568.6, 4641.1, 4649.2, 4661.7, 4675.3, 4685.4, and 4712.8. All of these but 4116.2, which is very faint, and 4649.2, which has a comparatively small intensity, agree fairly well in relative intensity with normal stars of Group II. The actual intensity of the lines, however, is less than in the normal stars, owing to the obscure aspect of the entire system of dark lines. Some dark lines may be present which are not among the known Orion lines, but it is extremely difficult in a spectrum of this kind to distinguish between true dark lines and spaces between bright lines.

163. The spectrum of this star nearly resembles that of γ Cassiopeiæ. See Remark 162. The most important difference is that the first reversal of the hydrogen lines is less marked than in γ, while the second is more so; that is, the bright bands are fainter and the central dark lines stronger. The wide underlying dark bands also, except in the line Hγ, are weak, and in most of the hydrogen lines are replaced by fine and delicate lines lying on either side of the bright band. Thus the lines Hδ, Hϵ, Hζ, Hη, Hθ, and Hι appear triple, with a stronger central component and a fine yet hazy line on either side. In Hζ the central line is sharp and narrow, but of great intensity, while the companion lines are very faint. In Hκ the companion line of shortest wave length disappears, (compare the apparent displacement of this line seen in γ Cassiopeiæ,) and in general one or other of these fine companion lines may be extremely faint or invisible. In the case of Hγ the underlying dark band retains its wide and unbroken character, but in the case of Hβ the bright band alone appears, without either underlying dark band or dark companion lines. Of the bright bands, those of Hβ and Hγ have great intensity, the former being the brightest. In Hδ, Hϵ, Hζ, and Hη the bright band may be said to be neutral, or of the same intensity as the continuous spectrum. It however appears brighter where it borders the dark central line on the edge of greater wave length, the central dark line then appearing faintly and narrowly bright edged. In the remaining hydrogen lines, which include Hλ and possibly others of shorter wave length, no traces of bright lines are seen. The star further agrees with γ Cassiopeiæ in the bright bands and spaces seen elsewhere in the spectrum, some of these being even more distinct than in γ. As the spectrum of this star has not been photographed by the use of erythrosin, it is uncertain whether the portion whose wave length exceeds that of Hβ also resembles the spectrum of γ Cassiopeiæ. The dark bands or lines present are nearly the same as in γ, but the Orion lines 4089.2, 4072.0, and 4069.4, seen in γ, are absent, and the lines 4387.8, 4712.8, 4120.5, and 4116.2, and the band covering 4675.8, 4661.7, and 4649.2, are faint or invisible. The Orion line 4925.7, not seen in γ, is perhaps present, and partially reversed.

164. This star resembles γ Cassiopeiæ and ϕ Persei, showing the same double reversal of the lines of hydrogen. See Remarks 162 and 163. The bright bands here present, however, are less intense, distinct brightness appearing only in the lines Hβ and Hγ. The underlying dark bands and fine central dark lines are well shown in Hβ and Hγ, and the former are more distinct on the edge of greater wave length of the bright band. The line Hδ appears indistinctly triple, while in Hϵ the central dark line alone is clearly defined, and the entire line appears narrow in consequence. The remaining lines of hydrogen are probably hazy bands of considerable width; the photographs, however, are poor in the ultra-violet. The bright bands and spaces seen elsewhere in the spectra of γ Cassiopeiæ and ϕ Persei are present in this star, but are less distinct, owing partly to the faintness of the image. The dark spectrum is on the whole more distinct than in the two above mentioned stars, and presents in many respects an agreement with normal spectra of Group III. The following Orion lines are shown in the photographs of π Aquarii: 4026.4, 4471.8, 4387.8, 4144.0, 4009.5, 3819.2, 3927.1, 4712.8, 4675.3, 4649.2, 4641.1, 4568.6, 4531.4, 4120.5, 4069.4 to 4072.0, and a faint band covering 4598.2 and 4591.6. The line 4531.4 is strong.

165. This star is in some degree allied to those of Group III., but is remarkable for a partial but very conspicuous reversal of the hydrogen lines and of some of the Orion lines. In these cases the dark lines are bordered by bright

lines on the side of greater wave length. The width of the bright lines or bands may be less than, or may, as in the case of $H\beta$, $H\gamma$, and $H\zeta$, exceed that of the dark line. The lines of hydrogen showing these bright borders or bands are $H\gamma$, $H\beta$, $H\delta$, $H\zeta$, $H\epsilon$, $H\eta$, and probably $H\theta$, $H\kappa$, and $H\iota$, the intensity of the bands declining in about the order given. The Orion lines having bright bands are 4471.8, 4026.4, 4712.8, 3819.2, 4925.7, 4120.5, 5023, and 3994.9, the intensity of the bands decreasing in about the order given. Two lines of unknown wave length, one near 4416, but of slightly greater wave length, and the other of still greater wave length, and probably a third of greater wave length than the Orion line 4387.8, have narrow bright borders. The line 4387.8 appears to be bright on the edge of shorter wave length. This, however, has not been confirmed with certainty. The above description applies rather to the spectrum as photographed with two prisms. With one prism the width and aspect of bright and dark bands vary, and the latter are frequently obliterated by the superposition of the former. Here, too, the bright bands $H\gamma$ and $H\delta$ have dark borders on the edge of greater wave length. As these are not clearly seen in the photographs taken with two prisms, it is uncertain whether they are true borders of the hydrogen lines or additional dark lines. The dark lines of the spectrum bear considerable resemblance to those of the typical star of Group III., Division *a*, but show differences in relative intensity, while some anomalous lines are present. The line K and line 3994.9 are much too strong for the group if the star is assumed to be of Division *a*, but would be normal were it of Division *c*. As all the lines are narrow, sharp, and conspicuous, the star is probably of this division. It is unfortunate that no star of Division *c* has been found belonging to Group III., or the adjacent groups, bright enough to be photographed with two prisms. Otherwise it might appear that the anomalous intensities and wave lengths in some of the lines of P Cygni were characteristic of that division. It is at least to be noted that this star alone of all those of Orion type with bright lines studied in this investigation has the dark lines narrow. The Orion lines shown in the photographs are 5023, 4925.7, 4712.8, 4675.3, 4661.7, 4649.2, 4641.1, 4576.5, 4568.6, 4553.4, 4471.8, 4387.8, 4144.0, 4120.5, 4116.2, 4089.2, 4072.0, 4069.4, 4026.4, 4009.5, 3994.9, 3927.1, and 3819.2, besides nine lines of unknown wave length, three of which have bright borders. It is important to note that the dark $H\zeta$ appears to be slightly displaced in the direction of shorter wave length, while a line of moderate intensity is present having wave length a little less than that of the Orion line 3964.6. This line and the displaced $H\zeta$ are the most conspicuous of the dark lines which change their positions in the spectrum of β Lyræ.

166. This variable star, which has a spectrum of the Orion type, but containing also bright lines, is remarkable for a series of changes which occur in the same period as the variations in light. Bright bands accompany the hydrogen lines $H\beta$, $H\zeta$, $H\gamma$, and $H\delta$, the first three being strong, the last of less intensity. Similar bands accompany the Orion lines 4471.8, 4712.8, 4026.4, 4387.8, 4144.0, 5023, 3819.2, 4925.7, 4120.5, and 3856.2, the first in order being about equal in width and brilliancy to the bright bands of $H\beta$ and $H\gamma$, the rest being less bright and decreasing in the order named. It has been announced in a previous publication of the Observatory, that from primary minimum to secondary minimum these bright bands have somewhat greater wave length than the dark lines, while at other times they are of shorter wave length than the dark lines. At or about the secondary minimum they lie centrally upon the dark lines, while at primary minimum their position, though not yet ascertained with certainty, is probably nearly the same. It is further found that the width and brightness of the bands vary, and that shortly before the primary minimum they become for the most part invisible. These changes in the bright bands may thus be briefly described. About a day after the primary minimum, or some hours later, the entire number is present. They are strong, but not very wide. Later, they widen gradually, and after the secondary minimum those in the region having wave length greater than 4340.7 are extremely wide. The latter are also very bright, but those of shorter wave length than 4340.7 are weak or invisible. After the second maximum all the bright bands, now wide and ill defined, fade by degrees, so that on the day before primary minimum nothing is seen of them but a faint brightness about $H\beta$, and sometimes a trace accompanying $H\zeta$. Some hours before the primary minimum they begin to reappear, brightening gradually till they regain their former intensity. A singular series of changes taking place meanwhile in the dark lines of the star points to the conclusion that there are at least three revolving bodies. Of these one appears to have a spectrum belonging to Division *c* in Group VII., approaching Group VI., the second to be approximately of Group IV., and the third to be a star of the Orion type, whose more precise nature has not yet been determined. The second of these spectra contains the bright bands. Its spectrum resembles that of P Cygni in an apparent displacement of the hydrogen line $H\zeta$ by shortening its wave length, and also in the presence of a conspicuous line nearly coincident with Orion line 3964.6, but apparently having shorter wave length. The phenomena shown among the dark lines of the spectrum during each light cycle may be thus briefly described. A few hours after secondary minimum the dark lines of the star, many of which lie under the bright bands, are single and extremely narrow. The spectrum is then that of a star belonging to Division *c* in Group VII., approaching Group VI. in the presence of Orion lines. The only features not proper to these groups are the bright bands, the slightly displaced $H\zeta$, and the line above mentioned, occupying nearly the position of Orion line 3964.6. This phase probably lasts but a few hours, after which the dark lines increase in width as the bright bands diminish in wave length. A new set of delicate dark lines then becomes visible underneath the bright bands. As the latter widen and fade, the dark lines become more and more clearly revealed. At the same time the original dark lines of the spectrum again decrease in width till the two spectra are equal. About the time of the second maximum this double character of the spectrum is beautifully shown, the components of the double lines being then equal, narrow, clearly defined, and widely separated. Now it is a fact of importance that all the lines of the spectrum, as seen at the secondary minimum, do not participate in this doubling. Those which are seen double are Hγ, Hδ, Hε, K, and the Orion lines 4026.4, 4471.8, 4387.8, 4144.0, 4481.4, and perhaps 4712.8, 4120.5, and 4009.5. Hβ appeared triple, owing probably to the presence of the dark border common in stars of the Orion type having bright lines, while Hζ was widely separated from the displaced Hζ previously united with it, the doubling being clearly shown even in the plates taken with one prism. It is evident that the double lines here enumerated are those common to stars of Group VII., Division *c*, approaching Group VI., Division *c*, and stars belonging to Group IV. Also, that they include all the principal lines of Group IV. spectra which would be clearly shown in the photographs of so faint a star when taken with two prisms. On the other hand, the lines which are peculiar to Group VII., Division *c*, remained single. These include a number of solar lines and the conspicuous Orion lines 4131.4 and 4128.5. The latter are very useful in distinguishing between the spectra and identifying that of Group VII., Division *c*, throughout its motions. It is thus made evident that after the single phase following secondary minimum the bright bands and the lines belonging to Group IV., together with the displaced line Hζ and the anomalous line near the Orion line 3964.6, were simultaneously diminishing in wave length. The maximum separation of the two spectra is reached at, or a little beyond, the time of second maximum, when it is very well marked. After this it decreases slowly to the end of the cycle, photographs taken a few hours before minimum showing the spectra nearly coincident. It is to be regretted that, owing chiefly to the faintness of the star, no good photographs have been obtained exactly at minimum with a sufficient dispersion to show the condition of the dark lines. Photographs taken within twelve hours after minimum show a singularly altered phase. The dark lines now appear either indistinctly triple, or dense, wide, and obscurely separable into two very unequal and hazy components, that of greater wave length being twice as wide and dense as the other. The triple character is well shown in the line Hδ and the Orion line 4026.4. The separate spectra were identified by matching the lines peculiar to the star belonging to Group VII., Division *c*, with the corresponding lines of a comparison star of similar type, β Orionis being found the most convenient for this purpose. It then appeared that the lines in the spectrum of Group IV., with the displaced line Hζ and the other peculiar line, had increased in wave length since the phase before minimum, and nearly coincided with that of the star of Group VII., Division *c*. Whether, as seemed likely, owing to the altered position of the bright bands, the spectrum of the former star had crossed that of the latter, could not be determined, owing to the ragged and hazy aspect of the compound lines. No doubt was left that the third set of lines, which were those of shortest wave length, belonged to neither of the two stars. It therefore appeared that the spectrum of a new body, previously invisible, had come into view. This was confirmed by the marked increase in the average intensity of the lines of the spectrum, by the reversal of relative intensities suddenly shown in some of the lines, and by the appearance of other lines not before seen. The widening which has been described as occurring in the lines of the star belonging to Group VII., Division *c*, after secondary minimum and their subsequent diminution in width, neither of which phenomena was due to the component whose spectrum is of Group IV., may have been caused by the revolution of such a third body. The triple phase occurring after primary minimum is of very short duration, the dark lines becoming clearly single about twelve hours after minimum. The aspect of the spectrum, however, in this phase of singleness, is very different from that seen at secondary minimum. The lines, instead of being fine and delicate, are now strong and dense. The altered intensity shown in some of them during the triple phase persists, though in a less degree. The bright bands, it will be remembered, are at this time of greater wave length than the dark lines. This phase is of comparatively long duration, lasting until about half a day before first maximum. At this time a new phase appears, in which the dark lines are certainly double, and probably triple. In those which appear double the division is, as a rule, unequal. The slight degree of separation, and the generally obscure character of the entire spectrum, render the separation of the compound lines difficult. Hβ, Hγ, Hδ, K, and perhaps 4009.5, however, have been found double in the best photographs, while Hε, 4026.4, and 4387.8 have appeared triple. The encroachment of the strong bright bands, which, though lying chiefly on the side of greater wave length, yet overspread the compound system of dark lines, may prevent the detection of the third component. The clear and simple doubling of the line K, however, which is entirely without a bright band, cannot be thus explained; so that if a third body is present the line K must be very faint or absent in its spectrum. An identification of the separate spectra by means of a comparison star showed that the spectrum belonging to Group VII., Division *c*, occupies in this phase the position of shorter wave length, while that belonging to Group IV., with its bright bands, occupies the position of greater wave length. The relative positions of the two bodies are therefore reversed since the preceding maximum. This double or triple phase lasts for a short period, not yet precisely ascertained, within three days after the first maximum. The spectrum then passes into the phase occurring near primary minimum, with which this description began. This completes the record of the more striking phenomena occurring in each light cycle of the variable. The fact appears to be established that the bright bands accompany a spectrum approximately of Group IV., which oscillates periodically over one of Group VII., Division *c*. The fact that the bright bands have a residual motion of their own, which places them sometimes toward the red and sometimes toward the violet end of their own system of dark lines, and at other times upon the lines of one or both spectra, is not yet explained, nor is the reason given for the fading of the bright bands. The supposition of a third body explains most of the remaining phenomena, and is rendered more probable by the fact that the times of recurrence of the phases vary within limits in different light cycles of the star. It would also explain the fact that deviations from the normal phases frequently occur, these deviations consisting generally in an altered width of the lines of the spectrum belonging to Group VII., Division *c*. Other peculiarities, however, as, for example, the occasional obliteration of the line Hγ of the above mentioned spectrum, cannot be thus explained, and in fact the rapid and complex transformations of this variable will probably not be fully understood till they are continuously followed.

167. This star combines the spectra of Group VIII., Division *a*, and Group IV., Division *b*, but has additional peculiarities. The aspect of the hydrogen lines is very singular, and probably subject to change. In the best photograph taken with two prisms the line Hβ is invisible, and this is not due to faintness of the image. In this plate the lines Hγ and Hδ are extremely narrow, and Hε shows an apparent diminution in wave length. (Compare line Hκ in γ Cassiopeiæ and φ Persei.) The narrowness of Hδ in this photograph may be due to the disappearance of the component of shorter wave length seen in another photograph, which shows the line Hδ double. The width of the hydrogen lines is somewhat greater in the remaining photographs, and probably varies. The line Hβ is present in all the other plates, and the line Hε is probably of normal wave length. Anomalous lines of slightly greater wave length than Hδ and Hε are present, but apparently not close enough to be associated with the hydrogen system. In the photograph taken with less dispersion traces of a bright band are seen bordering Hγ on the side of shorter wave length. The photographs are too faint to furnish a clear interpretation of the phenomena.

168. The system of dark lines in the spectrum of this star belongs to Group IV., Division *b*. The lines are wide. The line Hβ has a strong bright band centrally superposed, and the line Hγ has a similar central band, which is however narrower and of less intensity. The dispersion is not sufficient to show whether there is a double reversal in the lines of hydrogen.

169. The system of dark lines in the spectrum of the star belongs to Group IV., Division *b*. The width of the lines, however, exceeds that of ordinary stars of Division *b*, and equals that seen in γ Cassiopeiæ. As in that star also, a double reversal is shown in the lines of hydrogen. On the wide dark band Hβ a strong bright band is centrally superposed, while a similar but fainter bright band is superposed on Hγ. This latter bright band is centrally divided by a fine dark line. The lines Hδ and Hε do not show a distinctly bright band, but appear triple, with the central component strongest. The remaining lines of hydrogen are wide and dense. The Orion lines 4026.4, 3819.2, 4471.8, and probably others, are double. The bright band of γ Cassiopeiæ, lying between the Orion lines 4576.5 and 4591.6, besides several other fainter bright bands of that star, are present.

170. The system of dark lines in the spectrum of this star belongs to Group IV., Division *b*, but the lines are extremely wide. The dark line Hβ is accompanied by a bright band which was observed by Mrs. Fleming to lie on the edge of greater wave length in photographs taken December 14, 1888, December 23, 1889, and January 22, 1890, and to lie on the side of shorter wave length in those taken February 16 and 18, 1892, and March 7 of the same year. In plates taken December 17, 1891, and January 5 and 21, 1892, it is also on the edge of shorter wave length. The remaining lines of hydrogen show no bright components. They appear obscurely double in the plates taken with one prism, while in those taken with two prisms Hγ, Hδ, and Hε appear as strong but narrow central lines, having delicate and hazy companions on the side of greater wave length, and traces of still more hazy companions on the other side. As all these plates taken with two prisms show the phase in which the bright band of the line Hβ is of shorter wave length, the position of the extremely faint dark companions of Hγ and Hδ corresponds with that of the bright band. This object and β Lyræ are the only stars in which the bright bands are with certainty known to move from side to side of the dark lines. The fact that this star is triple is interesting in this connection. Many of the additional bright bands or spaces seen in γ Cassiopeiæ are faintly shown.

171. The system of dark lines in the spectrum of this star is of Group V., Division *b*, but the lines are extremely wide, and the star resembles in some degree γ Cassiopeiæ in the condition of the hydrogen lines. A bright band lies centrally on the wide dark band Hβ. The lines Hγ, Hδ, Hε, and perhaps Hζ, are without distinct bright components, but appear hazily triple, with the central component strong and the component of shorter wave length hazy and indistinct. Several of the bright spaces or bands seen in γ Cassiopeiæ, between Hβ and Hγ, are faintly visible in this star. The Orion lines are perhaps double.

172. The system of dark lines in the spectrum of this star belongs to Group V., Division *b*; but a bright band is superposed on the very wide dark band Hβ. This bright band is suspected of motion, since, while in most photographs it lies centrally on the dark band, in a few it lies on one or the other side of the centre. The remaining lines of hydrogen which appear in the plates taken with two prisms are either clearly triple, or, as is more common, show a strong but narrow central line, with haze on either side. This haze is, in the photographs studied, more abundant on the side of greater wave length, where fine dark lines are more or less clearly discernible in the midst of it. In a plate taken with two prisms, which showed the bright band of slightly shorter wave length than the centre of the dark band, the portion of the latter on the side of greater wave length than the bright band appeared obscurely double. This however needs confirmation.

173. The system of dark lines in the spectrum of this star belongs to Group V., Division *b*, but the lines are extremely wide. A bright band is superposed centrally on the wide dark band Hβ, and a less intense bright band lies upon Hγ. This last, being narrow as well as faint, gives the dark Hγ the appearance of being double. As the star is too faint to be photographed with a large dispersion, it is not certain whether the double reversal seen in γ Cassiopeiæ and other stars of this class takes place in the hydrogen lines of this star. The hydrogen lines having wave length shorter than Hγ are very dense, as well as wide, and would doubtless appear compound under higher dispersion. This star is Pleione.

174. The system of dark lines in the spectrum of this star belongs to Group IV., Division *b*, but all the lines are exceedingly wide. A distinct bright band lies almost centrally on the wide dark band Hβ. A fainter and narrower bright band or line lies upon Hγ, its position being commonly of slightly greater wave length than the centre. The lines Hδ and Hε appear in most photographs unequally divided, with the strong component occupying the true central position for each hydrogen line, and the weak and hazy component having the greater wave length. In some plates, however, both these lines and Hγ appear triple. Other lines of the spectrum sometimes appear unequally divided, with the stronger component of shorter wave length.

175. The line Hβ appears bright, and the remaining lines of hydrogen are very wide and obscurely double. The star also shows several of the bright bands of γ Cassiopeiæ between 4100 and 4860. The system of dark lines in the spectrum of this star probably belongs to Group IV., Division *b*.

176. This star is probably peculiar. The plate, which is very poor, shows only a continuous spectrum. This may possibly indicate that the lines are very narrow or partially reversed.

177. The line K has about four or five tenths of the intensity of Hδ.

178. The line K has from six to eight tenths of the intensity of Hδ.

179. The line K has about nine tenths of the intensity of Hδ.

180. The line K and the line Hδ are approximately equal.

181. The line K has about one and one tenth of the intensity of Hδ.

182. The line K has about one and five tenths times the intensity of Hδ. The lines of hydrogen have about seven tenths the intensity of those of α Canis Majoris.

183. The line K has about two and five tenths times the intensity of Hδ. The hydrogen lines have about seven tenths the intensity of those of α Canis Majoris.

184. This star resembles α Boötis in the absorption shown in the region having wave length shorter than 4307, and in the absence of increased brightness between the lines 4227.0 and 4215.7. See page 39 of Detailed Description.

185. This star resembles α Cassiopeiæ in the general absorption shown in the region having wave length shorter than 4307, and in the apparent brightness between lines 4227.0 and 4215.7. The line 4227.0 is also a little stronger than in α Boötis. See page 39 of Detailed Description.

186. The spectrum of the Sun so closely resembles that of stars of Group XIV. that it has been assumed as typical of that group. The slight differences which have been noticed in the intensity of individual lines of the Sun as compared with those of α Aurigæ and η Boötis, the other two typical stars of the group, have been stated in Remarks 92 and 93. The photographs of the Sun show a further difference in the distribution of light. This, however may be due to the different means, described on page 2, by which the photographs of the solar spectrum were obtained.

CHAPTER IX.

GENERAL CATALOGUE.

TABLE XII. gives in the order of right ascension the stars whose spectra have been examined and classified in the preceding chapters. The stars here given are identical with those in Tables IX., X., and XI., with the exception of B. D. +56° 2623, whose position for 1900 is R. A. $= 21^h\ 37^m.3$, Dec. $= +57°\ 8'$. See Remark 176.

The first column of this table contains the number taken from the Harvard Photometry. The second column gives the constellation, and the third, the Bayer letter and Flamsteed number. The fourth column gives the number from the Bonn or Cordoba Durchmusterung, this being in Italics when the star has been transferred by precession to the adjacent zone. The fifth and sixth columns give the position for 1900. The seventh column gives the group and division, the symbols here used being the same as those in Table IX. and elsewhere. The Roman numerals refer to groups; a number in Italics indicates that a star is intermediate between that and the next group. The letters *a*, *b*, *c*, refer to the three divisions known by these letters, the expression *ab* to stars intermediate between divisions *a* and *b*, *ac* to those intermediate between divisions *a* and *c*. The expression *a*,*b* indicates that it is not known to which of the divisions *a* or *b* the star belongs. The omission of the division letter indicates that the division is unknown. Stars of Groups XXI. and XXII., which are not included in the series, have not been assigned to any division. The letter *P* indicates that a star is peculiar. The letter *L* denotes a star of the Orion type having bright lines. To this a group number and division letter have been assigned when it was clear to what group the star would belong were the bright lines dark. The letter *C* denotes that the spectrum of the star is composite. The number denoting the group to which the principal spectrum belongs is then inserted. When the seventh column is vacant, the peculiarities of the star will be found in the remarks beginning on page 94, to which reference is made by the corresponding numbers given in the eighth column. The ninth column gives the number of plates employed in the study of each spectrum, and the tenth column the numbers by which these plates were designated, if not more than four plates were used. When more than four plates were used, the numbers of all after the first four are given in Table XIII. The eleventh column gives the number of prisms employed in making the photographs. When more than one number is given, some of the plates were taken with each number of prisms.

Numbers and letters referring to each of two lines are placed between them.

TABLE XII.

GENERAL CATALOGUE.

H. P.	Constellation.	B. Fl.	D.M.	R. A. 1900.	Dec. 1900.	Group. ✓	Remark. ✓	No. of Pls.	Plate Number.	No. of Dispersions.
				h. m.	° ′					
4259	Pisces	33	6357	0 0.3	− 6 16	XV.*a*	—	1	3071	1
5	Androm.	α 21	4	3.2	+28 33	VIII. *P*.	67	9	244, 630, 633, 643	4,2,1
9	Cassiop.	β 11	3	3.8	+58 36	XII.*ab*	—	8	351, 680, 865,2305	4,2,1
13	Androm.	22	17	5.1	+45 31	XI.*ac*	183	2	731, 758	1
23	Pegasus	γ 88	14	8.1	+14 38	IV.*a*	—	2	1638,2371	3,1
30	Cetus	7	21	9.6	−19 30	XVII.*a*	—	1	777	1
45	Cetus	ι 8	48	14.4	− 9 23	XV.*a*	185	1	2127	1
69	Cassiop.	λ 14	82	26.2	+53 59	V.*b*	30	1	1408	1
71	Cassiop.	κ 15	102	27.3	+62 23	II.*a*, *b*	11	1	1566	1
77	Cassiop.	—	102	30.5	+53 38	V.*b*	30	1	1408	1
82	Cassiop.	ζ 17	105	31.3	+53 21	IV.*a*	—	3	1377,1408,2164	2,1
92	Androm.	δ 31	91	33.9	+30 19	XV.*a*	185	1	1412	1
—	Pisces	—	85	34.2	+20 43	XV.*a*	184	2	736,1654	1
93	Pisces	55	87	34.6	+20 54	XV.*a*	184	2	736,1654	1
94	Cassiop.	α 18	*139*	34.8	+56 0	XV.*a*	—	8	625, 730,2373,5105	4,3,2,1
103	Cetus	β 16	115	38.5	−18 32	XV.*a*	185	4	640, 874,5111,5182	4,2,1
105	Cassiop.	—	181	38.8	+47 19	IV.*a*, *b*	—	1	2268	1
107	Cassiop.	ο 22	183	39.2	+47 44	IV.*a*, *b*	—	1	2268	1
119	Androm.	ζ 34	106	42.0	+23 43	XV.*a*	—	1	732	1
—	Pisces	—	*104*	42.2	+ 6 12	*XIV.a*	—	1	2258	1
120	Cassiop.	η 24	150	43.0	+57 17	XIII.*a*	90	3	862,1450,2379	3,1
122	Pisces	62	105	43.1	+ 6 45	XV.*a*	185	2	2252,2258	1
125	Pisces	δ 63	*107*	43.5	+ 7 2	XVI.*a*	—	3	761,2222,2258	1
136	Cassiop.	—	124	47.1	+60 34	XIII.*a*	—	2	197,2227	2,1
142	Cassiop.	γ 27	*144*	50.7	+60 10	*L.*	162	10	683, 884, 953,1032	4,2,1
145	Cassiop.	—	146	50.8	+59 50	VI.*b*	2,23	1	2227	1
148	Androm.	μ 37	175	51.1	+37 57	IX.*a*, *b*	178	2	2925,2955	1
—	Cepheus	—	*20*	52.8	+84 4	IX.*a*, *b*	177	1	847	1
155	Cepheus	*2*	19	54.9	+85 43	XV.*a*	114?,185	1	1648	1
172	Cetus	28	230	1 1.1	−10 23	VIII.*a*, *b*	65	1	1627	1
179	Cetus	30	238	2.7	−10 19	XIII.*a*	34	1	1627	1
183	Cetus	η 31	240	3.5	−10 43	XV.*a*	185	1	1627	1
180	Cepheus	—	*34*	3.6	+79 8	VIII.*b*	—	4	855,3093,6355,6480	2,1
185	Androm.	β 43	*198*	4.1	+35 5	XVII.*a*	—	12	721, 725, 945, 965	4,2,1
—	Cepheus	—	36	7.6	+79 23	*XI.*	20	4	855,3093,6355,6480	2,1
219	Cassiop.	δ 37	248	19.2	+59 43	X.*ab*	179	2	833,2293	4,1
213	Urs. Min.	α 1	8	22.0	+88 46	XIII.*ac*	—	7	437,1602,1610,2209	4,2,1
220	Cetus	θ 45	244	19.0	− 8 42	XV.*a*	115,185	1	1639	1
239	Pisces	η 99	231	26.2	+14 50	*XIV.a*	101	1	1629	1
—	Perseus	—	*460*	30.3	+48 12	XV.*a*	—	1	1697	1
—	Perseus	—	466	31.6	+47 55	XII.*a*	20	1	1697	1
251	Perseus	υ 51	*467*	31.8	+48 7	XV.*a*	114,185	2	1697,2323	1
269	Perseus	φ 54	*444*	37.4	+50 11	*L.*	163	3	848,1594,1615	1
287	Cassiop.	ε 45	*320*	47.2	+63 11	*IV.ab*	27	3	753, 917,1743	2,1
289	Triangul.	α 2	*312*	47.3	+29 6	XII.*a*	—	2	1607,1621	1
291	Aries	γ 5	243	48.0	+18 48	VIII. *P*.	72	2	5983,7028	2

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295	Aries	β 6	306	1 49.1	+20 19	X.a	32,76,179	4	2120,5996,6046,6055	2,1
304	Cassiop.	A 48	153	53.8	+70 25	IX.a, b	177	2	841,2397	1
306	Cassiop.	50	117	54.9	+71 56	VIII.a	—	1	2511	1
309	Pisces	112	311	55.0	+ 2 38	XIV.a	—	1	2317	1
315	Cetus	υ 59	358	55.3	−21 34	XVI.a	—	1	829	1
320	Pisces	α 113	317	56.9	+ 2 17	IX.C	159	3	771,2128,2317	1
324	Androm.	γ 57	395	57.7	+41 51	XV.C	144	10	367,1448,2254,2381	4,3,2,1
332	Aries	κ 12	*279*	2 1.0	+22 11	VIII.b	23	1	3041	1
333	Aries	α 13	*306*	1.5	+23 0	XV.a	113,185	6	981,1547,3041,5154	4,2,1
336	Triangul.	β 4	381	3.5	+34 31	X.a	75,179	6	2354,6128,6153,6161	3,2
356	Triangul.	7	409	10.0	+32 54	VII.b	—	5	2426,2490,6207,6379	1
360	Triangul.	δ 8	395	10.8	+33 46	XIV.a	—	2	2426,2490	1
361	Triangul.	γ 9	397	11.3	+33 23	VII.b	49	5	2426,6207,6265,6379	2,1
370	Cetus	ο 68	353	14.3	− 3 26	XX.a	131	16	245, 280, 288, 742	4,2,1
375	Cetus	69	355	16.8	− 0 4	XVI.a	—	1	759	1
401	Cassiop.	—	140	28.5	+72 23	XV.a	—	2	882, 897	1
—	Perseus	—	*722*	33.6	+49 8	VII.b	—	2	1611,1663	1
418	Cetus	δ 82	406	34.4	− 0 6	IV.a	10	1	1632	1
429	Perseus	θ 13	746	37.3	+48 48	*XIII.a*	—	2	1611,1663	1
433	Cetus	γ 86	422	38.1	+ 2 48	VIII.b	—	2	2141,2390	3,1
437	Cetus	μ 87	359	39.5	+ 9 41	X.a, b	2,181	1	2322	1
443	Perseus	η 15	714	43.4	+55 29	XV.a	—	1	1640	1
445	Aries	41	471	44.1	+26 51	VI.ab	—	6	2324,6002,6054,6463	2,1
454	Perseus	τ 18	641	47.2	+52 22	XIV.C	152	2	1616,2320	1
464	Eridanus	η 3	553	51.5	− 9 18	XV.a	—	1	1623	1
470	Perseus	—	665	53.7	+51 57	V.a, b	—	1	1616	1
482	Cetus	α 92	419	57.1	+ 3 42	XVII.a	—	6	291,1561,5172,5193	4,2,1
—	Cetus	—	420	57.1	+ 3 58	V.b	23	2	291,5248	2,1
483	Perseus	γ 23	*654*	57.6	+53 7	XIV.C	149	2	842,2942	1
487	Eridanus	τ^8 11	1387	58.0	−24 1	IX.a, b	177	1	3033	1
489	Perseus	ρ 25	630	58.8	+38 27	XIX.a	—	5	283, 695, 967,1453	2,1
496	Perseus	β 26	673	3 1.6	+40 34	VI.a	—	15	674, 684, 709, 724	4,2,1
498	Perseus	κ 27	631	2.7	+44 29	XV.a	185	2	1649,1655	1
—	Perseus	—	634	4.5	+44 39	VII.a, b	30	2	1649,1655	1
—	Camelop.	—	*335*	7.5	+66 0	VIII.a, b	—	3	4469,5385,6321	2,1
—	Camelop.	—	338	8.8	+65 17	VIII.a, b	—	4	850,4469,5385,6321	2,1
516	Camelop.	—	340	11.2	+65 17	IV.b, L.	174	16	850, 853,3858,4469	2,1
521	Perseus	29	899	11.5	+49 51	*IV.a, b*	20	2	2257,6208	2,1
522	Perseus	31	902	12.0	+49 43	*IV.a, b*	20	3	2253,2257,6208	2,1
530	Eridanus	15	1146	13.9	−22 52	*XIV.a*	—	1	3048	1
533	Eridanus	τ^4 16	584	15.1	−22 7	XIX.a	—	1	3048	1
537	Perseus	—	899	16.1	+48 51	V.a, b	—	3	2253,2257,6208	2,1
541	Perseus	α 33	917	17.1	+49 30	*XII.ac*	—	8	371,1543,2113,2253	4,2,1
550	Taurus	ο 1	511	19.4	+ 8 40	*XIV.a*	—	7	1074,6047,6168,6397	4,2,1
552	Perseus	—	920	20.9	+48 43	*IV.a, b*	—	4	2235,5207,5257,6254	2,1
551	Camelop.	—	660	21.0	+59 36	*VI.c*	35	6	2159,3023,6067,6075	2,1
—	Perseus	—	944	21.7	+49 31	V.a, b	—	2	2253,2257	1
554	Taurus	ξ 2	439	21.8	+ 9 23	VI.b	—	7	1074,2124,6066,6168	4,2,1
553	Camelop.	—	607	21.9	+58 32	*VI.c*	36	3	3023,6075,6081	2,1
555	Perseus	34	945	22.2	+49 10	*IV.a, b*	20	6	2235,2253,2257,5207	2,1

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—	Camelop.	—	*608*	3 22.2	+59 2	VIII.*a, b*	23,2 ?	1	6081	2
560	Perseus	σ 35	843	23.5	+47 39	XV.*a*	185	1	2464	1
—	Perseus	—	844	23.5	+47 46	VI.*a, b*	20	1	2464	1
—	Perseus	—	846	24.5	+47 31	VI.*a, b*	12	1	2464	1
—	Perseus	—	847	25.0	+47 41	VII.*a, b*	43	1	2464	1
—	Perseus	—	850	26.2	+47 36	X.*a, b*	20,180	2	2464,4453	1
576	Eridanus	ε 18	697	28.2	− 9 48	XV.*P.*	123	2	1685,3030	1
—	Perseus	—	773	28.9	+46 46	VI.*a, b*	20	1	2464	1
578	Perseus	ψ 37	857	29.4	+47 51	V.*b L.*	172	7	2464,2966,3029,4326	3,2,1
579	Eridanus	τ^5 19	*628*	29.4	−21 58	VI.*b*	—	3	3094,6394,6466	2,1
—	Eridanus	—	704	29.8	−10 12	VIII.*a*	63	1	1685	1
591	Perseus	δ 39	876	35.8	+47 28	V.*b*	—	4	2966,3029,4305,6678	2,1
600	Perseus	ο 38	642	38.0	+31 59	III.*a, b*	—	2	1569,1737	2,1
602	Perseus	ν 41	815	38.4	+42 16	XII.*ac*	—	1	3870	4,1
—	Taurus	—	505	38.9	+23 59	V.*a, b*	—	2	294,1631	
608	Taurus	17	507	39.0	+23 48	V.*a*	29	3	201, 294,1631	2,1
—	Taurus	—	546	39.2	+24 32	VI.*a, b*	34	2	294,1631	1
610	Taurus	q 19	547	39.3	+24 10	V.*a*	—	3	201, 294,1631	2,1
613	Taurus	20	*516*	39.9	+24 4	V.*a*	—	3	201, 294,1631	2,1
—	Taurus	—	553	40.0	+24 15	VI.*a, b*	—	1	1631	1
—	Taurus	—	556	40.1	+24 13	VI.*a, b*	30	1	1631	1
612	Camelop.	—	369	40.4	+65 13	XVIII.*a*	82	1	778	1
615	Taurus	23	522	40.4	+23 39	V.*a*	29	3	201, 294,1631	2,1
—	Taurus	—	562	41.1	+24 13	VII.*a, b*	20	1	1631	1
—	Taurus	—	536	41.5	+23 48	VII.*a, b*	23,30	1	1631	1
618	Taurus	η 25	541	41.6	+23 48	V.*a*	—	3	201, 294,1631	2,1
—	Taurus	—	*563*	42.5	+23 8	VI.*a, b*	—	2	294,1631	1
—	Taurus	—	*553*	42.6	+24 3	VII.*a, b*	30	1	1631	1
—	Taurus	—	556	43.0	+23 34	X.*a, b*	20,181	1	1631	1
625	Taurus	27	557	43.3	+23 45	V.*a, b*	—	3	201, 294,1631	2,1
—	Taurus	—	558	43.3	+23 51	V.*b, L.*	173	1	1631	
—	Taurus	—	*561*	43.4	+24 5	VII.*a, b*	20	1	1631	1
—	Taurus	—	563	43.8	+23 25	VI.*a, b*	30	1	1631	1
—	Taurus	—	569	44.1	+23 33	VII.*a, b*	20	1	1631	1
638	Perseus	ζ 44	666	47.8	+31 35	III.*a*	16	2	1389,1733	2,1
647	Perseus	—	768	50.0	+34 47	IV.*b*	23	2	2496,6154	2,1
649	Perseus	ε 45	895	51.1	+39 43	II.*a*	2	3	3049,3072,7042	2,1
652	Perseus	ξ 46	775	52.4	+35 30	I.*b*	4	2	2496,6154	2,1
650	Cepheus	—	125	53.3	+80 26	XIII.*C.*	154	3	856,2467,2503	1
653	Eridanus	γ 34	781	53.4	−13 48	XVI.*a*	—	2	762, 766	1
657	Taurus	λ 35	539	55.2	+12 13	IV.*b*	—	3	679, 702, 792	1
665	Taurus	ν 88	581	57.8	+ 5 42	VIII.*a*	—	5	3073,6155,6216,6260	2,1
668	Taurus	40	584	58.4	+ 5 9	*IV.a*	—	4	273,6155,6216,6260	2,1
—	Cepheus	—	127	4 1.1	+80 17	XV.*a*	—	2	2467,2503	1
696	Eridanus	37	758	5.5	− 7 11	*XIV.a*	—	1	1669	1
701	Eridanus	o^1 38	764	7.0	− 7 6	XII.*a*	32,86	1	1669	1
702	Perseus	μ 51	1063	7.5	+48 9	XIV.*a*	95	1	1681	1
704	Cepheus	—	133	9.6	+80 35	XV.*a*	—	2	2467,2503	1
750	Taurus	δ 61	712	17.2	+17 18	XV.*a*	185	1	2326	1
752	Taurus	63	586	17.7	+16 32	IX.	—	1	2326	1

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756	Taurus	64	714	4 18.4	+17 13	IX.*a*, *b*	177	1	2326	1
763	Taurus	68	719	19.8	+17 42	VIII.*a*	—	1	2326	1
775	Taurus	θ^1 77	631	22.8	+15 44	XV.*a*	185	2	2181,3082	3,1
776	Taurus	θ^2 78	632	22.9	+15 39	X.*a*, *b*	180	1	2181,3082	3,1
783	Taurus	—	637	24.8	+15 59	IX.*a*, *b*	30,178	1	3082	1
797	Taurus	α 87	629	30.2	+16 19	XVI.*a*	—	14	199,1042,1442,1503	4,3,2,1
799	Eridanus	ν 48	834	31.3	− 3 34	IV.*a*	26	2	2992,4323	2,1
806	Eridanus	c 51	963	32.6	− 2 40	X.*a*, *b*	180	1	2992	1
812	Eridanus	53	933	33.6	−14 30	XV.*a*	184	1	1606	1
821	Eridanus	54	988	36.1	−19 52	XVIII.*a*	—	1	779	1
840	Orion	π^3 1	762	44.3	+ 6 47	XIII.*a*	—	3	1475,1624,4328	2,1
845	Orion	π^4 3	745	45.9	+ 5 26	*IV.a*	—	3	1650,2540,4328	2,1
850	Orion	o^1 4	777	46.9	+14 5	XVIII.*a*	—	1	813	1
854	Eridanus	ω 61	1068	48.0	− 5 37	X.*a*, *b*	181	4	1603,3024,3086,3099	1
855	Orion	5	800	48.2	+ 2 20	XVII.*a*	20	2	1580,1762	1
857	Orion	π^5 8	810	49.1	+ 2 17	*IV.a*	—	3	1580,1595,2476	1
862	Auriga	ι 3	*855*	50.4	+33 0	*XV.a*	—	6	1027,2213,6058,6145	4,2,1
876	Camelop.	10	856	54.5	+60 18	XIV.*ac*	—	4	849,1786,2602,2610	1
877	Auriga	ε 7	1166	54.8	+43 41	XII.*c*	—	6	1086,1460,1466,2310	4,3,2,1
879	Auriga	ζ 8	1142	55.5	+40 56	XV.*C.*	147	9	567,1730,2491,2497	2,1
—	Auriga	—	1044	56.2	+41 18	VIII.*a*	60	6	1567,2497,2527,6500	2,1
—	Orion	—	923	56.7	+ 0 34	XV.*a*	—	1	1768	1
—	Orion	—	886	56.8	+ 1 28	V.*a*, *b*	80	1	1768	1
896	Auriga	η 10	1058	59.5	+41 7	*IV.ab*	—	6	1567,1730,2491,2527	2,1
901	Lepus	ε 2	1000	5 1.2	−22 30	XVI.*a*	—	1	1754	1
906	Eridanus	66	1044	1.8	− 4 47	VII.*a*, *b*	20	1	2224	1
910	Eridanus	β 67	1162	2.9	− 5 13	IX.*b*	178	2	1081,2224	4,1
915	Eridanus	68	1056	3.8	− 4 35	XII.*a*	—	2	2224,2231	1
913	Camelop.	—	169	6.1	+79 7	XIII.*a*	—	1	859	1
929	Lepus	μ 5	1072	8.4	−16 19	VIII.*P.*	68	2	1756,6082	2,1
932	Auriga	α 13	1077	9.3	+45 54	XIV.*a*	39,92	13	191, 393, 429,1199	4,3,2,1
934	Auriga	—	980	9.7	+34 12	II.*a*, *b*	12	1	1694	1
936	Orion	β 19	1063	9.7	− 8 19	VI.*c*	—	12	399, 415,1492,1707	4,2,1
948	Orion	τ 20	*1028*	12.7	− 6 57	V.*b*	—	3	1763,6403,6467	2,1
975	Orion	η 28	1235	19.4	− 2 29	III.*a*	15	2	1055,1721	4
979	Orion	γ 24	919	19.7	+ 6 16	IV.*a*	—	6	386,3051,6380,6432	4,2,1
978	Taurus	β 112	795	20.0	+28 32	VI.*a*	32	5	236, 379,1128,1549	4,2
994	Lepus	β 9	1096	24.0	−20 51	XIV.*a*	96	2	1744,2225	2,1
1001	Auriga	χ 25	1024	26.2	+32 8	III.*a*, *b*	24	3	4673,4683,4701	1
1005	Orion	δ 34	983	26.9	− 0 23	II.*b*	—	4	422,1120,1468,6433	4,2,1
1012	Orion	35	947	28.2	+14 15	*IV.a*, *b*	—	1	1794	1
1014	Lepus	α 11	1166	28.3	−17 54	*XI.ac*	—	2	1088,2243	4,1
—	Orion	—	1167	29.4	− 4 52	IX.	—	1	1664	1
1017	Orion	ϕ^1 37	877	29.4	+ 9 25	II.*a*	2,6	1	1617	1
1019	Orion	λ 39	879	29.6	+ 9 52	I.*b*	—	3	335,1617,2436	4,1
1021	Orion	—	1234	30.1	− 6 5	III.*a*, *b*	22	3	805, 979,1664	2,1
1023	Orion	θ 41	1315	30.3	− 5 27	I.*b*	3	5	805, 979,1656,1664	2,1
1024	Orion	43	1319	30.4	− 5 29	III.*b*	20,21		805, 979,1656,1664	
1025	Orion	c 42	1085	30.4	− 4 54	III.*a*, *b*	23	4	979,1656,1664,1688	2,1
—	Orion	—	1186	30.5	− 4 26	IV.*a*, *b*	20	1	1664	1

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1027	Orion	ι 44	*1241*	5 30.5	− 5 59	I.*b*	2	3	805, 979,1664	2,1
1026	Orion	o 45	1188	30.7	− 4 55	XI.*a*, *b*	182	5	805, 979,1656,1664	2,1
1029	Orion	ε 46	969	31.2	− 1 16	II.*a*	—	5	120, 398,3977,6343	4,2,1
—	Orion	—	1334	31.3	− 5 43	IV.*a*, *b*	20	1	1664	1
1030	Orion	ϕ^2 40	898	31.4	+ 9 15	XV.*a*	121	2	1617,2436	1
—	Orion	—	1255	31.7	− 6 ·8	III.*a*, *b*	20	3	805,1656,1688	1
—	Orion	—	1016	31.9	+ 8 53	*IV.a*, *b*	—	1	1617	1
—	Orion	—	1196	32.9	− 4 52	III.*a*, *b*	20	1	1664	1
1039	Orion	σ 48	1326	33.7	− 2 39	II.*b*	8	3	241, 442, 446	4,2
1043	Orion	—	1166	34.5	− 3 37	II.*b*	9	3	6210,6434,6616	2
1045	Orion	ζ 50	1338	35.8	− 2 0	II.*b*	—	6	241, 442, 446,6210	4,2
1047	Orion	—	1004	35.8	− 1 11	IV.*b*	—	3	6210,6434,6616	
1057	Lepus	γ 13	1211	40.4	−22 28	XIII.*a*	—	3	3035,3050,3095	1
1065	Lepus	ζ 14	1232	42.4	−14 51	IX.*a*, *b*	23, 177	1	2492	1
1068	Orion	κ 53	1235	43.0	− 9 42	II.*a*	—	5	439,1115,2244,2281	4,2,1
1072	Auriga	υ 31	1336	44.2	+37 16	XVII.*a*	—	1	774	1
—	Auriga	—	1347	46.7	+37 19	XII.*a*	20	1	774	1
1086	Lepus	δ 15	1211	47.0	−20 54	XV.*a*	112,184	2	1608,2521	1
1089	Orion	χ^1 54	1162	48.5	+20 16	XIII.*a*	—	2	286,3273	2,1
1090	Orion	57	1126	49.1	+19 44	IV.*a*	—	2	286,3273	2,1
1091	Orion	α 58	1055	49.8	+ 7 23	XVIII.*a*	128	11	803,1043,1182,1203	4,3,2,1
—	Orion	U	—	49.9	+20 10	XX.	134	2	286,3273	2,1
1093	Auriga	δ 33	970	51.3	+54 17	XV.*a*	184	1	2616	1
1100	Auriga	β 34	1328	52.2	+44 57	VIII.*a*	56	14	413,1131,2264,2277	4,3,2,1
1101	Lepus	η 16	1286	51.8	−14 11	XII.*a*	85	1	1670	1
1102	Auriga	π 35	1217	52.5	+45 56	XVIII.*a*	—	1	775	1
1104	Auriga	θ 37	1380	52.9	+37 13	VIII.*P.*	70	10	443,1734,2311,6083	4,2,1
1119	Orion	64	1186	57.6	+19 41	VI.*a*, *b*	—	3	1801,2468,2502	1
1122	Orion	χ^2 62	1233	58.0	+20 8	III.*c*	—	3	1801,2468,2502	1
1124	Orion	—	1391	59.4	− 6 42	IV.*b*, *L.*	175	1	4499	1
1132	Orion	ν 67	1152	6 1.8	+14 47	IV.*a*, *b*	—	1	2483	1
1150	Orion	68	1253	6.0	+19 49	VII.*a*, *b*	55,42	3	2482,6389,6404	2,1
1153	Orion	ξ 70	1187	6.2	+14 14	IV.*a*, *b*	—	1	2483	1
1157	Monocer.	—	1446	7.0	− 6 31	IV.*a*, *b*	20	1	2576	1
1160	Gemini	η 7	1241	8.8	+22 33	XVIII.*a*	—	5	878,1465,1481,2599	1
1162	Orion	71	1270	9.0	+19 12	XII.*a*	2	3	2482,6521,6626	1
1195	Can. Maj.	ζ 1	3038	16.5	−30 2	*IV.b*	—	1	1738	2
1194	Gemini	μ 13	1304	16.9	+22 34	XVIII.*a*	2	2	773,2219	1
1201	Can. Maj.	β 2	1467	18.3	−17 55	III.*a*	—	7	1545,1722,2590,4539	4,3,1,2
—	Gemini	—	1347	19.4	+23 23	VII.*a*, *b*	23	1	2219	1
1205	Monocer.	T	1273	19.8	+ 7 8	XIV.*ac*	—	1	2504	1
1220	Monocer.	11	1574	24.0	− 6 58	IV.*b*, *L.*	170	10	1587,1671,2327,2435	2,1
1225	Camelop.	—	212	29.2	+79 41	XIII.*a*	—	1	2621	1
—	Auriga	—	1539	29.7	+38 31	XXI.	138	1	1573	1
1244	Auriga	51	1690	31.8	+39 29	XV.*a*	—	1	1573	1
1249	Gemini	γ 24	1223	31.9	+16 29	VIII.*a*	—	7	467,2265,4231,6344	4,2,1
1256	Monocer.	S 15	1220	35.5	+10 0	I.*b*	1	11	703, 716, 738, 746	1,2
1263	Gemini	ε 27	1406	37.8	+25 13	*XIV.a*	—	1	1641	1
1266	Gemini	30	1390	38.3	+13 20	XV.*a*	—	2	1686,2578	1
1272	Gemini	ξ 31	1396	39.7	+13 0	XII.*a*	—	3	1637,1686,2578	1

H. P.	Constellation.	B. Fl.	D.M.	R. A. 1900.	Dec. 1900.	Group.	Remark.	No. of Pls.	Plate Number.	No. of Dispersions.
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—	Gemini	—	1275	6 40.3	+12 49	XI.	80,182	1	1686	1
1275	Can. Maj.	α 9	1591	40.7	−16 34	VII.*a*	39	10	340, 356, 370, 411	4,2,1
1288	Camelop.	—	266	45.5	+77 6	XVI.*a*	—	1	879	1
1295	Gemini	θ 34	1481	46.2	+34 5	IX.*ab*	178	6	1056,1731,2418,3126	4,3,2,1
—	Can. Maj.	—	4553	49.2	−24 34	VIII.*b*	23	2	760, 834	
—	Can. Maj.	—	4565	49.8	−24 25	VIII.*b*	23	2	760, 834	
1292	Cepheus	—	51	53.9	+87 12	XVII.*a*	—	1	2629	1
1302	Lynx	15	982	48.6	+58 34	XV.*a*	—	1	2255	1
1312	Can. Maj.	o^1 16	4567	49.9	−24 4	*XIV.a*	109	4	760, 797, 831, 834	1
1311	Can. Maj.	—	4553	50.0	−23 48	XXII.	—	5	760, 797, 826, 831	4,3,2,1
1325	Can. Maj.	ε 21	3666	54.7	−28 50	III.*a*	17	5	1082,1785,6255,6357	4,2
1334	Gemini	ζ 43	1687	58.2	+20 43	XIV.*ac*	—	4	697, 704, 739,1469	1
1337	Can. Maj.	o^2 24	4797	58.8	−23 41	V.*c*	—	2	1039,2575	2,1
1340	Can. Maj.	γ 23	1625	59.2	−15 29	V.*a*	10	1	1755	1
1350	Can. Maj.	δ 25	3916	7 4.3	−26 14	XIII.*c*	—	9	453,1717,2245,2437	4,3,2,1
—	Monocer.	—	1634	6.3	− 0 8	XI.*ab*	182	4	1581,6148,6212,6219	2,1
1359	Monocer.	22	1636	6.8	− 0 19	VIII.*b*	32	4	1581,6148,6212,6219	2,1
1361	Gemini	51	1417	7.7	+16 20	XIX.*a*	20	1	808	1
—	Monocer.	—	1646	8.2	− 0 7	*XI.*	20	3	1581,6148,6212	2,1
1360	Camelop.	—	201	10.0	+82 36	XIX.*a*	—	1	1699	1
1368	Can. Maj.	27	4057	10.2	−26 10	IV.*a*	10	2	1665,2512	1
1370	Can. Maj.	28	4073	10.7	−26 35	IV.*b L.*	168	2	1665,2512	1
1373	Gemini	λ 54	1443	12.4	+16 43	IX.*a, b*	177	1	2532	1
1377	Gemini	δ 55	1645	14.2	+22 10	XI.*ab*	182	4	1575,1735,2220,2591	2,1
1383	Can. Maj.	—	4164	14.8	−26 25	XIV.*a*	65	1	1665	1
—	Gemini	—	1374	18.3	+27 50	*XI.*	22,31	2	1040,1749	4,2
1394	Gemini	ι 60	1385	19.5	+28 0	XV.*a*	—	3	1040,1749,2242	4,2,1
1399	Can. Maj.	η 31	4328	20.2	−29 7	V.*c*	—	6	1033,1776,2455,6358	4,3,2
1403	Can. Min.	β 3	1774	21.8	+ 8 29	VI.*b*	—	3	448,1745,2314	4,2,1
1405	Gemini	ρ 62	*1562*	22.7	+31 59	XI.*a, b*	182	1	1757	1
1409	Gemini	64	1396	23.1	+28 19	IX.	20	1	2242	1
1423	Gemini	α 66	1581	28.2	+32 7	VIII.*a*	—	5	395, 470, 484,2261	4,2,1
1430	Gemini	υ 69	1424	29.8	+27 7	XVI.*a*	—	1	1618	1
1442	Can. Min.	α 10	1739	34.1	+ 5 30	XII.*a*	—	6	387, 493,1518,2214	4,2,1
1445	Argo	κ	4707	34.7	−26 34	IV.*a, b*	11	1	1764	1
1452	Monocer.	26	2172	36.5	− 9 19	XV.*a*	185	1	1852	1
1453	Gemini	σ 75	1590	37.0	+29 7	XV.*a*	185	2	1869,5289	4,2,1
1457	Gemini	κ 77	1759	38.4	+24 38	*XIV.a*	101	1	1710	1
1459	Gemini	β 78	1463	39.2	+28 16	XV.*a*	184	6	394,1172,1187,1869	4,3,2,1
1462	Argo	τ 3	4774	39.8	−28 43	*VIII.ac*	—	4	1865,2522,6157,6604	2,1
1474	Argo	ξ 7	6030	45.1	−24 37	XIV.*P.*	100	3	2477,2541,3101	1
1492	Argo	e 11	2087	52.6	−22 37	XIV.*ac*	—	1	1524	1
1500	Argo	12	*2104*	54.8	−23 2	XV.*a*	20	1	1524	1
1515	Argo	ι 15	*6828*	8 3.3	−24 1	XII.*a*	82	2	1028,2328	4,1
1518	Argo	16	2190	4.5	−18 57	*IV.b*	23	1	1787	1
—	Camelop.	—	235	5.2	+82 44	VII.*b*	30	7	2315,2451,2533,2534	1
1521	Cancer	ζ 16	*1867*	6.5	+17 56	XIII.*a*	—	1	1712	1
1533	Cancer	β 17	1917	11.1	+ 9 30	*XV.a*	—	1	1657	1
—	Cancer	—	1921	12.1	+ 9 11	XV.*a*	—	1	1657	1
—	Cancer	—	1927	12.9	+ 9 28	V.*a, b*	20	1	1657	1

H. P.	Constellation.	B. Fl.	D.M.	R. A. 1900.	Dec. 1900.	Group.	Remark.	No. of Pls.	Plate Number.	No. of Disper-sions.
				h. m.	° ′					
1554	Monocer.	30	2339	8 20.7	− 3 35	VII.*b*	43,49	2	991,2493	2,1
1558	Urs. Maj.	ο 1	1054	22.0	+61 3	XIV.*a*	2	2	838,1666	1
—	Urs. Maj.	—	1136	22.9	+60 15	XII.*a*	31	1	1666	1
—	Camelop.	—	253	28.4	+82 36	VII.*a*, *b*	20	7	2315,2451,2533,3121	1
1580	Urs. Maj.	π^1 3	643	30.3	+65 22	*XIV.a*	—	1	2408	1
1582	Hydra	—	*1997*	30.5	+ 6 58	XIII.*a*	30	4	5441,6426,6468,6522	2,1
1584	Urs. Maj.	π^2 4	698	31.5	+64 40	XV.*a*	—	1	2408	1
1588	Hydra	δ 4	2001	32.3	+ 6 3	VIII.*b*	32,50	7	2531,5409,5441,6426	2,1
1599	Hydra	η 7	2039	38.0	+ 3 46	*IV.ab*	28	1	1770	1
1605	Cancer	ι 48	1824	40.6	+29 7	*XIV.a*	108	1	1651	1
1608	Hydra	ε 11	2036	41.5	+ 6 48	XIII.*a*	—	1	1795	1
1613	Hydra	ρ 13	2040	43.1	+ 6 13	VII.*a*, *b*	23	1	1795	1
1629	Hydra	ζ 16	2060	50.1	+ 6 19	XV.*a*	185	1	1802	1
1636	Urs. Maj.	ι 9	1707	52.4	+48 27	X.*ab*	180	5	1076,1848,2404,5427	2
1638	Urs. Maj.	ρ 8	551	53.5	+68 1	XVIII.*a*	—	2	804,1700	1
1641	Urs. Maj.	10	1956	54.2	+42 11	XII.*a*	84	2	1861,1904	1
1645	Urs. Maj.	κ 12	1633	56.9	+47 34	VIII.*b*	—	8	1848,2404,2628,4544	2,1
1651	Urs. Maj.	σ^1 11	573	59.6	+67 17	XVI.*a*	—	2	1700,1765	1
1655	Urs. Maj.	σ^2 13	577	9 1.6	+67 32	XIII.*a*	32	2	1700,1765	1
1658	Urs. Maj.	τ 14	*723*	2.7	+63 55	XII.*C.*	161	2	843,2321	1
1663	Argo	—	6895	3.7	−25 27	XVI.*a*	—	1	832	1
1676	Hydra	θ 22	2167	9.1	+ 2 44	VII.*b*	—	5	1758,2484,6445,6561	2,1
1681	Lynx	38	1965	12.6	+37 14	VIII.*ab*	55,60	3	1822,2505,5393	2,1
1685	Lynx	40	*1979*	15.0	+34 49	XVI.*a*	—	2	1576,1740	4,2,1
1698	Hydra	α 30	2680	22.6	− 8 13	*XV.a*	—	6	962,1029,1121,2517	4,3,2,1
1695	Draco	—	302	22.8	+81 46	XV.*a*	114,185	1	1695	1
1701	Urs. Maj.	h 23	845	23.6	+63 30	XI.*a*, *b*	78,183	3	845,1844,2586	3,1
1709	Urs. Maj.	θ 25	1401	26.3	+52 8	XIII.*a*	32	1	1746	4,2
1715	Urs. Maj.	26	1402	28.0	+52 30	VIII.*b*	54	1	1746	2
1734	Hydra	ι 35	2231	34.8	− 0 42	XV.*a*	—	2	1597,1833	1
1740	Leo	ο 14	2044	35.8	+10 21	XII.*C*	157	1	1619	1
1747	Leo	ε 17	2129	40.2	+24 14	XIV.*P*	99	4	1750,2312,6630,6640	4,2,1
1752	Leo	R	*2096*	42.2	+11 53	XX.*a*	132	2	2470,2478	1
1753	Urs. Maj.	υ 29	1268	44.0	+59 30	*XI.ac*	—	2	1678,2553	1
1760	Leo	μ 24	2019	47.1	+26 29	XV.*a*	185	1	1841	1
1782	Leo	π 29	2301	54.9	+ 8 32	XVII.*a*	—	2	1788,1854	1
1793	Leo	η 30	2171	10 1.9	+17 15	VII.*c*	—	4	1771,5489,6530,6581	2,1
1797	Leo	α 32	2149	3.1	+12 28	VI.*b*	—	13	460, 471, 479, 490	4,2,1
1800	Hydra	λ 41	2120	5.7	−11 51	XV.*a*	185	1	1625	1
1810	Urs. Maj.	λ 33	2005	11.0	+43 25	VIII.*a*	—	2	1772,5517	2,1
1811	Leo	35	2207	11.0	+24 0	XIV.*a*	20	1	2524	2,1
1812	Leo	ζ 36	*2209*	11.1	+23 55	*XI.ab*	—	3	948,1747,2524	4,2,1
—	Camelop.	—	287	11.7	+83 19	XV.*a*	—	1	1691	1
—	Leo	—	2207	11.8	+23 37	XII.*a*	31	1	2524	1
1821	Leo	40	*2466*	14.3	+19 59	XII.*a*	31	2	449, 964	4,2
1823	Leo	γ 41	2467	14.4	+20 21	XV.*a*	107,184	5	449, 964,1122,5436	4,2
1827	Urs. Maj.	μ 34	2115	16.4	+42 0	XVI.*a*	—	3	867,1041,2233	4,1
1831	Camelop.	—	297	19.0	+83 4	XII.*a*	88	1	1691	1
1837	Hydra	μ 42	3052	21.2	−16 20	XVI.*a*	—	2	1589,1817	1
1859	Leo	ρ 47	*2166*	27.5	+ 9 49	II. *P.*	13	3	1658,1842,2514	1

H. P.	Constellation.	B. Fl.	D.M.	R. A. 1900.		Dec. 1900.		Group.	Remark.	No. of Pls.	Plate Number.	No. of Dispersions.
				h.	*m.*	°	′					
1869	Hydra	U	3218	10	32.6	−12	51	XXI.	140	3	1582,1823,2485	1
—	Hydra	—	2925		33.9	−11	56	VII.*b*	54	2	1582,1823	1
1893	Hydra	ν 4	3138		44.7	−15	40	XVII.*a*	125	2	1100,6545	4,2
1902	Leo Min.	46	2172		47.7	+34	45	XV.*a*	185	2	1677,1845	1
1906	Leo Min.	47	2178		49.4	+34	34	XV.*a*	—	2	1677,1845	1
1907	Urs. Maj.	46	2181		50.2	+34	2	XV.*a*	—	1	1845	1
1918	Crater	α 7	3273		54.9	−17	46	XV.*a*	—	1	1804	1
1923	Urs. Maj.	β 48	*1302*		55.9	+56	55	VIII.*a*	32	5	420, 468,1160,2266	4,2,1
1925	Leo	b 60	2547		57.0	+20	43	VIII.*a*	61	2	1035,6705	4,2
1926	Urs. Maj.	α 50	1161		57.6	+62	18	XV.*a*	184	3	480,2665,5527	4,3,2
1941	Urs. Maj.	ψ 52	1897	11	4.0	+45	3	XV.*a*	119,120	3	1071,1094,2525	4,1
1949	Leo	δ 68	2298		8.8	+21	5	IX.*b*	178	10	418,1035,1078,1777	4,3,2,1
1951	Leo	θ 70	*2234*		9.0	+15	59	VIII.*a*	32	6	1084,1741,1966,6458	2
1952	Leo	72	2322		9.9	+23	39	XVIII.*a*	—	1	1818	1
1959	Urs. Maj.	ξ 53	2132		12.9	+32	6	XIV.*a*	—	1	1679	1
1961	Urs. Maj.	ν 54	2098		13.1	+33	39	XV.*a*	112,184	1	1831	1
1963	Crater	δ 12	*3345*		14.4	−14	14	XV.*a*	184	1	1759	1
1965	Leo	σ 77	2437		16.0	+ 6	35	VII.*a*	42	5	1809,6531,6690,6740	2,1
1969	Leo	ι 78	2348		18.7	+11	5	XII.*a*	—	1	1626	1
1972	Leo	—	*2335*		19.8	+11	59	XV.*a*	—	1	1626	1
1973	Crater	γ 15	*3244*		19.9	−17	8	IX.*a*, *b*	178	2	1797,2506	1
1988	Draco	λ 1	*665*		25.5	+69	53	XVII.*a*	32?	4	814,2579,2594,4939	2,1
1999	Draco	2	*670*		30.2	+69	52	XV.*a*	184	1	814	1
2019	Virgo	ν 3	2479		40.7	+ 7	6	XVII.*a*	—	2	1824,2639	1
2018	Urs. Maj.	χ 63	1966		40.8	+48	20	XV.*a*	—	1	1653	1
2025	Leo	β 94	2383		44.0	+15	8	IX.*b*	178	8	454, 469, 472, 963	4,2,1
2028	Virgo	β 5	2489		45.5	+ 2	20	XIII.*a*	—	1	1773	1
2036	Urs. Maj.	γ 64	1475		48.6	+54	15	VIII.*b*	32	5	474, 510,1133,2518	4,2,1
2057	Virgo	ο 9	2583	12	0.1	+ 9	18	*XIV.a*	104	1	1696	1
2056	Draco	—	461		0.2	+77	28	XV.*a*	185	2	1713,1849	1
2063	Corvus	ε 2	*3487*		5.0	−22	3	XV.*a*	185	1	2507	4,1
2070	Draco	—	412		7.5	+78	10	X.*a*, *b*	77,180	3	1713,1849,1896	1
2077	Urs. Maj.	δ 69	1363		10.5	+57	35	IX.*b*	32,177	4	425,1839,2526,2707	4,3,1
2078	Corvus	γ 4	3424		10.7	−16	59	VI.*a*	33	4	1030,1778,2440,2550	4,3,1
2088	Virgo	η 15	2926		14.8	− 0	6	VIII.*a*	—	1	2480	1
2120	Corvus	δ 7	3482		24.7	−15	57	VII.*b*	48	4	1066,1779,2622,3713	4,3,2,1
2124	Draco	4	*700*		25.7	+69	45	XVIII.*a*	—	9	1767,1900,4646,4656	2,1
2128	Corvus	η 8	3489		26.9	−15	38	*XI.*	30,81	2	2622,3713	2,1
2134	Corvus	β 9	3401		29.1	−22	50	*XIV.a*	103	3	1054,1064,2549	4,1
2135	Draco	κ 5	703		29.2	+70	20	V.*b* *L.*	171	29	1282,4746,4772,4778	2,1
2141	Draco	6	705		30.5	+70	34	*XIV.a*	—	9	1282,1900,4514,4646	1
2155	Virgo	γ 29	2601		36.6	− 0	54	XI.*ab*	183	4	1072,1742,1963,2565	4,2,1
2164	Can. Ven.	—	1817		40.5	+46	0	XXI.	139	1	1892	1
2167	Com. Ber.	27	2533		41.6	+17	8	XVI.*a*	32	1	1760	1
2191	Urs. Maj.	ε 77	1627		49.6	+56	30	VIII.*P.*	66	12	417, 426, 487,2537	4,2,1
2193	Virgo	δ 43	*2669*		50.6	+ 3	57	XVIII.*a*	—	4	881, 914,1805,2600	1
2195	Can. Ven.	12	*2580*		51.4	+38	52	VIII.*P.*	69	4	1046,2514,6516,6544	4,2,1
2201	Com. Ber.	36	*2682*		54.0	+17	57	XVII.*a*	32	2	1874,1879	1
2207	Urs. Maj.	78	*1408*		56.5	+56	55	XI.*a*, *b*	183	3	2744,2760,2826	1
2208	Virgo	ε 47	2529		57.2	+11	30	XV.*a*	185	2	1036,2645	4,1

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2232	Com. Ber.	43	2193	13	7.3	+28	22	XIV.*a*	—	1	1870	1
2249	Hydra	γ 46	3554		13.5	−22	39	*XIV.a*	104,101	2	1085,2508	4,1
2263	Virgo	α 67	3672		19.9	−10	38	III.*b*	18	19	431, 457, 502, 506	4,3,2,1
2264	Urs. Maj.	ζ 79	1598		19.9	+55	27	VIII.*a*	56	10	427, 441, 968,1652	4,3,2,1
2267	Urs. Maj.	g 80	1603		21.2	+55	30	IX.*b*	178	8	968,1652,2287,2291	4,2,1
2294	Virgo	ζ 79	*3076*		29.6	− 0	5	IX.*b*	177	4	1294,6615,6624,6667	3,1
2298	Urs. Maj.	81	*1667*		30.3	+55	52	VIII.*P.*	71	2	5213,5231	2
2338	Urs. Maj.	η 85	*2027*		43.6	+49	49	IV.*b*	—	5	482, 566,1118,1908	4,2
2343	Boötes	υ 5	2564		44.6	+16	17	XVI.*a*	—	3	1620,1811,1846	1
2356	Draco	i 10	963		48.5	+65	13	XVIII.*a*	—	2	1893,2535	1
2360	Boötes	η 8	2725		49.9	+18	54	XIV.*a*	93	3	1047,1065,1970	4,1
2378	Hydra	π 49	10095	14	0.7	−26	12	XV.*a*	—	1	2551	1
2381	Draco	α 11	*978*		1.7	+64	51	VII.*a*	43,44	6	2073,2573,2587,2651	3,2,1
2400	Boötes	α 16	2777		11.1	+19	44	XV.*a*	—	14	87, 401, 475,1184	4,3,2,1
2426	Boötes	θ 23	1804		21.8	+52	19	XIII.*a*	—	1	1875	1
2433	Boötes	ρ 25	*2628*		27.6	+30	49	XV.*a*	—	2	1312,6945	1
2437	Urs. Min.	5	527		27.7	+76	8	*XV.a*	—	2	1353,6972	1
2436	Boötes	γ 27	2565		28.0	+38	45	XI.*ab*	182	5	1059,2544,2566,6546	4,2,1
2442	Boötes	σ 28	2536		30.3	+30	11	*XI.a, b*	30	2	1312,6945	1
2457	Virgo	μ 107	3936		37.8	− 5	13	XII.*a*	—	1	1300	1
2467	Boötes	ε 36	2417		40.6	+27	30	XV.*C.*	150	9	969,1123,1130,1161	4,2,1
2468	Virgo	109	2862		41.2	+ 2	19	VIII.*b*	32	5	994,1967,2623,6681	2,1
2479	Libra	8	3965		45,2	−15	35	XII.*a*	31	2	2630,3714	2,1
2481	Boötes	—	2593		45.2	+38	13	XI.*a, b*	20,182	3	2510,2741,6946	1
2480	Libra	α 9	3966		45.4	−15	37	IX.*ab*	177	5	1079,1297,2630,3710	4,2,1
2488	Boötes	—	2580		46.6	+37	40	XV.*a*	—	2	2510,2741	1
2500	Urs. Min.	β 7	595		51.0	+74	34	XVI.*a*	32	5	501, 844, 985,2552	4,2,1
2506	Libra	δ 19	*3938*		55.6	− 8	7	VII.*a*	—	7	1692,1880,2580,2748	2
2510	Urs. Maj.	—	878		56.0	+66	20	XIX.*a*	—	5	1313,1338,1347,1427	1
—	Libra	—	3946		57.1	− 7	27	VIII.*a*	54	2	1692,2580	2
2515	Boötes	β 42	2840		58.2	+40	47	*XIV.a*	104,101	2	1305,1306	1
2514	Scorpius	γ 20	11834		58.3	−24	53	XVIII*a.*	—	1	1298	1
2541	Boötes	δ 49	2561	15	11.5	+33	42	XV*a.*	184	2	1092,2028	4,1
2539	Libra	β 27	*3935*		11.6	− 9	1	VI.*b*	—	4	2640,2692,6803,6828	4,3,2,1
2555	Urs. Min.	11	678		17.2	+72	11	XV.*a*	—	2	1276,2567	1
2566	Urs. Min.	γ 13	679		20.9	+72	11	IX.*b*	178	5	1276,1316,2017,2572	3,1
2563	Serpens	τ^1 9	2858		21.1	+15	47	XVII.*a*	65	2	1871,1905	1
2569	Draco	ι 12	1654		22.7	+59	19	XV.*a*	2,185	1	1855	4,1
2572	Corona	β 3	2670		23.7	+29	27	XI.*P*	79,182	5	1308,1761,1850,6847	2,1
2586	Libra	37	4171		28.7	− 9	43	XV.*a*	—	1	2761	1
2587	Libra	—	4010		29.0	− 8	51	*IV.a, b*	—	3	1667,2561,2821	1
2589	Libra	γ 38	4237		29.9	−14	27	XV.*a*	184	1	1320	1
2594	Corona	α 5	2512		30.4	+27	3	VIII.*ab*	51	6	535,1037,1135,1968	4,2,1
2595	Scorpius	*39*	10464		30.9	−27	48	XV.*a*	—	1	1326	1
2601	Scorpius	ο *40*	11837		32.6	−29	27	IV.*a, b*	20	1	1886	1
2625	Corona	γ 8	2722		38.5	+26	36	VIII.*ab*	51	6	1330,6633,6693,6706	2,1
2627	Serpens	α 24	3088		39.3	+ 6	44	XV.*a*	185	5	559,1087,1101,2563	4,2,1
2632	Serpens	β 28	2911		41.6	+15	44	IX.*b*	73,178	4	1332,6730,6737,6770	2,1
2636	Serpens	κ 35	3074		44.2	+18	27	XVI.*a*	—	1	1335	1
2638	Serpens	μ 32	*4052*		44.4	− 3	8	VII.*a*	41	7	1337,1806,2771,2822	1 .

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2645	Serpens	ε 37	3069	15	45.8	+ 4	46	VIII.*a*	59	7	1350,2007,2118,2624	1
2662	Scorpius	ρ 5	11714		50.7	−28	55	IV.*b*	23	1	1901	1
2666	Serpens	γ 41	2849		51.8	+16	0	XIII.*a*	32,91	3	2033,2636,6908	1
2671	Scorpius	π 6	11228		52.8	−25	49	III.*b*	—	5	488, 970,1960,6782	2,1
2673	Corona	ε 13	2558		53.5	+27	10	XV.*a*	—	1	1999	1
2674	Scorpius	δ 7	4068		54.4	−22	20	III.*P.*	25	3	563,6750,6800	4,2
2688	Scorpius	ξ 51	*4237*		58.9	−11	6	XIII.*a*	—	1	2646	1
2690	Scorpius	β 8	4307		59.6	−19	32	III.*b*	19	5	1283,2641,2702,6735	3,2,1
2696	Draco	θ 13	1608	16	0.1	+58	50	XIII.*a*	—	1	2037	1
2698	Scorpius	ω^1 9	4405		1.0	−20	24	III.*b*	—	4	1906,2702,6735,6779	3,2,1
2700	Scorpius	ω^2 10	4408		1.6	−20	36	XIV.*a*	—	2	6735,6779	1
2713	Hercules	φ 11	2376		5.6	+45	12	VII.*a*	45	5	2632,2765,2910,6738	2,1
2726	Ophiuch.	δ 1	3903		9.1	− 3	26	XVII.*a*	127	4	1277,1295,6911,6912	1
2736	Ophiuch.	ε 2	4086		13.0	− 4	27	XV.*a*	184	1	1881	1
2738	Scorpius	σ 20	11485		15.1	−25	21	II.*a, b*	10	2	2766,2804	1
2745	Hercules	τ 22	2169		16.7	+46	33	V.*a*	—	3	1309,1876,6772	1
2747	Hercules	γ 20	3086		17.5	+19	23	XI.*a, b*	182	4	1973,2780,2805,2811	1
2764	Scorpius	α 21	11359		23.2	−26	13	XVII.*C.*	155	9	560,1104,1185,1216	4,2,1
2772	Hercules	g 30	2714		25.3	+42	6	*XIX.a*	129	2	1902,2607	1
2773	Ophiuch.	λ 10	3118		25.9	+ 2	13	VIII.*a*	57	2	1303,2625	1
2774	Hercules	β 27	2934		26.0	+21	42	XV.*a*	32,184	2	2681,2693	3,1
2783	Scorpius	τ 23	*11015*		29.7	−28	0	II.*a, b*	2	1	2816	1
2787	Hercules	σ 35	2724		30.9	+42	39	VII.*b*	52,43,53	5	2613,2618,2634,3855	3,2,1
2788	Ophiuch.	ζ 13	4350		31.7	−10	22	II.*b*	2,7	4	2726,2798,3743,6849	3,2,1
2802	Hercules	42	2531		36.1	+49	7	XVIII.*a*	32	3	2626,6910,6917	2,1
2807	Hercules	ζ 40	2884		37.5	+31	47	XIV.*a*	94	2	2823,2864	1
2810	Hercules	η 44	3029		39.5	+39	7	XV.*a*	119,120	3	3798,3850,3871	1
2838	Ophiuch.	κ 27	3298		53.0	+ 9	32	XV.*a*	185	2	1331,2045	1
2851	Urs. Min.	ε 22	498		56.2	+82	12	*XIV.a*	105	2	1358,1372	1
2844	Hercules	ε 58	2947		56.5	+31	4	VII.*a*	42	6	1887,6158,6196,6205	2,1
2849	Hercules	*32*	3179		58.6	+14	14	XVIII.*a*	65	1	1327	1
2852	Hercules	*33*	3292		59.1	+13	44	VII.*a, b*	20	1	1327	1
2868	Ophiuch.	η 35	4467	17	4.6	−15	36	VIII.*a*	—	5	565, 567,2002,2024	4,2,1
2878	Draco	ζ 22	1170		8.5	+65	50	V.*a*	10	2	1355,2635.	1
2879	Hercules	α 64	3207		10.1	+14	30	*XIX.a*	—	7	459,1261,1274,1281	4,2,1
2880	Hercules	δ 65	*3221*		11.0	+24	57	VIII.*b*	2	6	1856,2608,2614,2708	3,2,1
2885	Hercules	π 67	2844		11.5	+36	55	*XV.a*	—	2	1317,2781	1
2890	Hercules	u 68	2864		13.6	+33	18	*IV.a, b*	—	1	1964	1
2893	Hercules	e 69	2864		14.2	+37	24	VIII.*a*	58	2	1317,2781	1
2899	Ophiuch.	θ 42	13292		15.8	−24	54	*IV.a, b*	—	1	1894	1
2914	Hercules	ρ 75	2878		20.2	+37	14	VII.*b*	—	1	2000	1
2920	Ophiuch.	—	3368		21.5	+ 7	41	XII.*C.*	158	2	2799,6913	1
2937	Draco	β 23	2065		28.1	+52	23	XIV.*a*	—	1	2959	1
2944	Ophiuch.	α 55	3252		30.3	+12	38	X.*b*	180	6	1124,1157,1969,6682	4,2,1
2947	Serpens	ξ 55	4621		31.8	−15	20	X.*a, b*	180	3	1978,2906,2932	1
2959	Hercules	ι 85	2349		36.6	+46	3	IV.*b*	—	2	1386,1995	1
2962	Ophiuch.	β 60	3489		38.5	+ 4	36	XV.*a*	185	1	1378	1
2976	Hercules	μ 86	2888		42.6	+27	48	*XIV.a*	102	2	1363,2006	1
2979	Ophiuch.	γ 62	3403		42.9	+ 2	44	VII.*b*	—	4	2029,2082,2643,6806	2,1
3003	Draco	ξ 32	2033		51.8	+56	55	XV.*a*	114?,185	1	2588	1

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3005	Ophiuch.	ν 64	4632	17 53.5	− 9 45	XV.*a*	—	2	1961,2911	1
3007	Hercules	ξ 92	3156	53.8	+29 15	XV.*a*	185	4	1390,1409,2921,2946	1
3009	Draco	γ 33	2282	54.3	+51 31	XVI.*a*	—	7	575, 578,1981,2960	4,2,1
3010	Hercules	ν 94	3098	54.7	+30 11	XI.*ac*	183	4	1382,1390,2946,2994	1
3017	Ophiuch.	67	3458	55.7	+ 2 56	V.*c*	—	4	1333,2052,2918,3861	1
3023	Ophiuch.	68	3560	56.7	+ 1 19	VII.*b*	20	1	2762	1
3037	Ophiuch.	70	3482	18 0.4	+ 2 32	XV.*a*	112,184	1	2800	1
3045	Ophiuch.	72	3564	2.6	+ 9 33	IX.*a*, *b*	177	2	2034,2832	1
3047	Hercules	b 99	3128	3.2	+30 33	XIII.*a*	20	1	1396	1
3048	Hercules	o 103	2925	3.6	+28 45	VII.*b*	—	6	734,1359,2943,3012	2,1
3051	Hercules	102	3674	4.4	+20 48	IV.*a*	10	1	2746	1
3053	Hercules	101	3675	4.6	+20 1	IX.*a*, *b*	178	1	2746	1
3071	Draco	40	570	7.5	+79 59	XII.*a*	87	3	1405,1851,2568	1
3062	Sagittar.	μ 13	4908	7.8	−21 5	VI.*c*	—	2	2888,2903	1
3065	Hercules	A 104	3199	8.2	+31 22	XVII.*a*	—	2	2026,3088	1
3069	Sagittar.	15	5054	9.3	−20 46	*VI.c*	38	1	2903	1
3084	Sagittar.	δ 19	14834	14.6	−29 52	XV.*a*	185	3	2853,2885,2913	1
3090	Serpens	η 58	4599	16.1	− 2 56	XV.*a*	184	1	2030	1
3107	Hercules	109	3411	19.4	+21 43	XV.*a*	—	2	1361,1413	1
✓ 3120	Draco	φ 43	889	22.2	+71 17	VII.*P*.	43,44	7	2609,2637,6087,6169	2,1
3122	Draco	χ 44	839	22.8	+72 42	XIII.*a*	—	2	1416,6087	1
3136	Draco	d 45	2113	30.9	+56 58	XIII.*c*	—	1	2620	1
3147	Lyra	α 3	3238	33.6	+38 41	VII.*a*	40	7	476, 547, 570, 654	4,3,2,1
3157	Sagittar.	φ 27	13170	39.4	−27 6	VI.*a*	—	3	2818,2860,6865	2,1
3171	Hercules	110	3926	41.4	+20 27	XII.*a*	2	1	2001	1
3191	Lyra	8	3227	46.1	+32 42	IV.*a*, *b*	—	4	740,1477,6905,6914	1
3192	Lyra	ν 9	3228	46.2	+32 26	IX.	65	4	682, 740,1477,3096	1
3193	Lyra	β 10	3223	46.3	+33 15	*C, L.*	166	17	290, 672, 682,3768	2,1
3199	Sagittar.	σ 34	13595	49.1	−26 25	IV.*b*	—	5	652,1988,2776,2856	4,2,1
3207	Lyra	δ^1 11	3307	50.2	+36 51	IV.*b*	—	1	810	1
3210	Lyra	δ^2 12	3319	51.0	+36 47	XIX.*a*	—	1	810	1
3224	Lyra	R 13	3117	52.3	+43 49	*XIX.a*	—	2	1459,3018	1
—	Lyra	—	3017	53.0	+44 5	VIII.*a*, *b*	20	2	1459,3018	1
3225	Lyra	—	3267	53.3	+32 47	XIV.*a*	—	1	287	1
3232	Lyra	γ 14	3286	55.2	+32 33	VII.*a*	41,42,46	5	1399,2738,3202,5840	2,1
—	Lyra	—	3132	56.1	+43 35	VIII.*a*, *b*	20,22	2	1459,3118	1
3252	Sagittar.	o 39	5237	58.7	−21 53	XV.*a*	—	2	2861,2884	1
3259	Aquila	ζ 17	3899	19 0.8	+13 43	VII.*b*	47	6	1299,2694,2796,5879	3,2,1
3260	Aquila	λ 16	4876	0.9	− 5 2	VII.*b*	42,51	8	1888,2801,2908,2933	2,1
3270	Sagittar.	π 41	5275	3.8	−21 11	*XI.ac*	—	3	1296,2837,2854	1
3291	Lyra	η 20	3490	10.4	+38 58	*IV.b*	—	1	1369	1
3307	Draco	δ 57	1129	12.5	+67 29	XV.*a*	119,120	1	1374	1
3316	Cygnus	κ 1	2216	14.8	+53 11	XV.*a*	—	2	2137,2155	1
3319	Sagittar.	ρ 44	5322	15.9	−18 2	X.*a*, *b*	180	2	2777,2806	1
3321	Sagittar.	υ 46	5283	16.0	−16 8	*C, L.*	167	5	5011,5030,5050,6831	2
3328	Draco	τ 60	857	17.5	+73 10	XV.*a*	185	1	1364	1
3342	Cygnus	2	3584	20.2	+29 26	IV.*a*, *b*	11	1	735	1
3343	Aquila	δ 30	3879	20.5	+ 2 55	XI.*a*, *b*	182	2	1417,2790	1
3357	Vulpec.	6	3759	24.6	+24 28	XVII.*a*	—	1	791	1
3361	Cygnus	7	2434	25.0	+52 7	VII.*a*	30	1	2835	1

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3362	Cygnus	β 6	3410	19 26.7	+27 45	XV.*C.*	145	3	1379,1393,1449	1
3365	Cygnus	ι 10	2605	27.2	+51 31	IX.*a*, *b*	74,178	2	2815,2835	1
3393	Cygnus	θ 13	*3062*	33.7	+50 0	XII.*a*	—	3	1391,1406,2919	1
3407	Cygnus	—	2949	37.7	+45 17	*XI.*	30,81	2	2173,2316	2,1
3418	Aquila	γ 50	4043	41.5	+10 22	*XV.a*	—	2	1302,2964	1
3419	Cygnus	δ 18	3234	41.9	+44 53	VII.*b*	50,42	6	2173,2316,2703,2712	4,2,1
3420	Cygnus	17	3587	42.6	+33 30	XII.*a*	—	2	6354,6387	2
3421	Sagitta	δ 7	4240	42.9	+18 17	*XVII.C.*	148	5	815,1348,1997,2894	1
3424	Sagitta	ζ 8	4254	44.5	+18 53	VIII.*b*	60	6	815,1348,1997,2836	1
3429	Aquila	α 53	4236	45.9	+ 8 36	X.*b*	180	13	171, 172, 237, 561	4,3,2,1
3434	Cygnus	χ	3593	46.7	+32 40	XX.*P.*	135	6	2774,2789,6135,6318	2,1
3436	Aquila	η 55	4337	47.4	+ 0 45	XIV.*ac*	—	9	677, 687, 691, 748	1
3445	Aquila	58	*3871*	49.6	+ 0 1	VII.*a*	22,30	3	1445,1446,1451	1
3447	Draco	ε 63	*1070*	48.5	+70 1	XV.*a*	184	2	3003,3079	1
3450	Aquila	β 60	4357	50.4	+ 6 10	XV.*a*	184	2	478,2046	4,1
3460	Cygnus	η 21	3798	52.6	+34 49	XV.*a*	—	1	2899	1
3466	Sagitta	γ 12	4229	54.3	+19 13	XVI.*a*	—	2	2912,3019	1
3498	Draco	e 64	1405	20 0.4	+64 32	XVII.*a*	—	1	3089	1
3514	Aquila	θ 65	3911	6.2	− 1 7	VII.*a*	43	2	2019,6014	2,1
3515	Vulpec.	18	3815	6.4	+26 37	VIII.*b*	—	5	3001,5887,6078,6165	2,1
3519	Vulpec.	19	3825	7.6	+26 31	XV.*a*	2,117,185	3	3001,6165,6915	2,1
3520	Vulpec.	20	3828	7.8	+26 11	VI.*b*	23	3	3001,5887,6915	2,1
—	Cygnus	—	*3821*	8.4	+38 3	XXII.	141	1	846	1
3527	Cygnus	o^1 30	2881	10.2	+46 31	IX.*b*	23,177	5	1383,1384,2036,2039	1
3528	Cygnus	31	2882	10.5	+46 26	XV.*C.*	146	6	1376,1383,1384,2036	1
3530	Vulpec.	—	4165	11.0	+25 17	IV.*b*	—	1	5887	2
3537	Capricor.	α^1 5	5683	12.1	−12 50	XIV.*a*	20	1	794	1
3541	Cygnus	o^2 32	3059	12.3	+47 24	*XIV.a*	110	6	1376,1383,1384,2036	1
3538	Capricor.	α^2 6	5685	12.5	−12 52	XV.*a*	—	1	794	1
—	Cygnus	—	*3987*	13.3	+37 7	XXII.	142	1	1473	1
3547	Cygnus	P 34	3871	14.1	+37 43	*L.*	165	9	700, 741,1433,4881	2,1
3550	Cygnus	36	3998	14.8	+36 41	VIII.*a*	—	2	1433,5168	1
3551	Cygnus	35	3967	14.8	+34 40	*XII.c*	89	1	5132	1
3552	Capricor.	ν 8	5642	15.1	−13 4	VII.*b*	23	1	794	1
3554	Capricor.	β 9	5629	15.4	−15 5	XIV.*C.*	151	3	2043,2053,2093	1
—	Cygnus	—	4010	15.8	+38 25	XXII.	143	1	1473	1
3564	Cygnus	γ 37	4159	18.6	+39 56	XIII.*c*	—	6	505, 615, 634,2018	4,2,1
3583	Cygnus	41	*4057*	25.3	+30 2	*XII.ac*	—	1	1397	1
3592	Delphin.	ε 2	4321	28.4	+10 58	V.*a*	10	2	2817,2845	1
3600	Delphin.	ζ 4	4353	30.6	+14 20	VIII.*b*	54,60	3	1336,2050,2846	1
3605	Delphin.	β 6	4369	32.8	+14 15	XII.*a*	83	4	1336,2050,2846,6041	2,1
3622	Delphin.	—	4220	34.4	+15 29	IV.*b*	—	2	2855,6174	2,1
3624	Delphin.	α 9	4222	35.0	+15 33	*VI.b*	—	6	2077,2855,2915,5880	2,1
3631	Cygnus	α 50	3541	38.0	+44 56	VIII.*c*	—	10	477, 655,1486,1507	4,3,2,1
3635	Delphin.	δ 11	4403	38.8	+14 43	IX.*a*, *b*	20,178	1	2077	1
3645	Delphin.	γ 12	4255	42.0	+15 46	*XIV.a*	106,107	4	3053,3091,6909,6920	1
3648	Cygnus	ε 53	4018	42.1	+33 36	XV.*a*	184	4	1434,1463,5920,6079	4,2,1
3647	Aquarius	ε 2	*5506*	42.3	− 9 52	VIII.*a*	—	6	2129,2778,2791,6200	2,1
3649	Aquarius	3	5378	42.4	− 5 23	XVIII.*a*	34	1	3066	1
3654	Cygnus	T	*4028*	43.2	+34 1	XV.*a*	—	4	1434,1463,2953,6079	2,1

H. P.	Constellation.	B. Fl.	D.M.	R. A. 1900.		Dec. 1900.		Group.	Remark.	No. of Pls.	Plate Number.	No. of Dispersions.
				h.	*m.*	°	′					
3656	Cepheus	η 3	2050	20	43.2	+61	26	XV.*a*	184	1	1387	1
3708	Cygnus	—	4325		59.2	+38	16	XV.*a*	—	1	2742	1
3716	Cygnus	ξ 62	3800	21	1.3	+43	32	XVI.*a*	—	1	3848	1
3717	Cygnus	61	4343		2.1	+38	13	XVI.*a*	124	3	2742,2858,2866	1
—	T Cephei	—	*1291*		8.2	+68	5	XX.*P.*	136	2	2775,2784	1
3732	Cygnus	ζ 64	4348		8.7	+29	49	XV.*a*	185	1	1394	1
3736	Cepheus	—	2334		9.3	+59	34	III.*a*, *b*	20	2	3022,6932	1
3739	Equuleus	α 8	4635		10.8	+ 4	50	XIII.*C.*	153	5	1414,2785,2792,2802	1
3741	Cygnus	τ 65	4240		10.8	+37	36	*XI.a, b*	—	3	1388,2868,2902	1
3747	Cygnus	υ 66	4371		13.8	+34	28	IV.*b*, *L.*	169	25	3026,3120,3298,4332	2,1
3750	Cygnus	A 68	3877		14.8	+43	31	I.*b*	—	7	6916,6941,6970,6975	1
3757	Cepheus	α 5	*2111*		16.2	+62	10	X.*b*	180	4	624, 653,2004,5894	4,2,1
3779	Capricor.	ζ 34	15388		20.9	−22	51	*XIV.P.*	111	4	2828,2934,3075,7017	2,1
3780	Capricor.	35	6020		21.5	−21	37	*XIV.a*	101	2	2828,3075	1
3792	Pegasus	2	4325		25.5	+23	12	XVII.*a*	—	1	780	1
3795	Aquarius	β 22	5770		26.3	− 6	1	XIV.*a*	—	3	1354,1643,6930	1
3798	Cepheus	β 8	*1173*		27.4	+70	7	III.*a*	—	3	1407,2366,2747	3,1
3807	Cygnus	ρ 73	*3865*		30.2	+45	9	XV.*a*	118	2	2057,2865	1
—	Cygnus	—	3877		32.3	+44	56	*XIX.a*	130	2	1592,2865	1
—	Cygnus	—	3889		33.6	+44	14	IX.	—	1	1592	1
3818	Capricor.	γ 40	6340		34.6	−17	7	*XI.C.*	160	3	2044,2833,3044	1
3821	Cepheus	—	*2617*		35.8	+57	2	I.*b*	5	2	2920,3031	1
—	Cepheus	—	*2623*		37.3	+57	8	—	176	1	3031	1
3836	Pegasus	ε 8	4891		39.2	+ 9	25	XV.*a*	2,116,185	7	1556,2069,2072,2088	4,2,1
—	Cepheus	—	2314		39.7	+58	48	XV.*a*	122	3	1439,1478,1525	1
3843	Pegasus	κ 10	*4463*		40.2	+25	11	XII.*a*	—	1	1630	1
3845	Cepheus	μ	2316		40.4	+58	20	XVII.*a*	126	5	1439,1478,1525,3005	1
—	Pegasus	—	*4471*		41.4	+25	6	V.*a*, *b*	31	1	1630	1
3848	Capricor.	δ 49	5943		41.5	−16	35	X.*a*, *b*	181	1	2838	1
—	Pegasus	—	*4473*		41.8	+25	6	XV.*a*	—	1	1630	1
3896	Aquarius	32	4242		59.7	− 1	24	IX.*a*, *b*	178	3	1328,3069,5971	2,1
3899	Aquarius	α 34	*4246*	22	0.7	− 0	49	XIV.*ac*	—	3	1328,3069,5971	2,1
3907	Pegasus	ι 24	4533		2.3	+24	51	XII.*a*	—	1	1418	1
—	Pegasus	—	*4540*		3.7	+25	3	XI.*a*, *b*	182	1	1418	1
3913	Pegasus	θ 26	4961		5.2	+ 5	42	VIII.*a*	60	4	2879,2935,3025,3039	1
3923	Cepheus	ζ 21	2475		7.4	+57	43	XV.*a*	2,185	3	673, 696,1341	1
3926	Cepheus	—	2727		8.2	+56	21	XIII.*a*	—	3	1467,2797,2808	1
3942	Cepheus	ε 23	2741		11.3	+56	33	X.*a*, *b*	181	3	1467,2797,2808	1
—	Cepheus	—	2746		12.8	+56	43	*XIV.a*	105	2	1467,2808	1
3950	Aquarius	γ 48	*5741*		16.5	− 1	53	VII.*a*	—	5	2881,2939,6192,6198	2,1
3960	Aquarius	π 52	4872		20.2	+ 0	53	*L.*	164	12	1426,1662,1680,2900	2,1
3962	Lacerta	4	3715		20.4	+48	58	*VI.c*	37	3	2424,2433,6015	2,1
3970	Aquarius	ζ 55	4365		23.7	− 0	32	XII.*a*	82	2	2054,2940	1
3981	Cepheus	δ 27	2548		25.4	+57	54	XIV.*ac*	98	2	1435,1447	1
3987	Lacerta	7	3875		27.1	+49	46	VIII.*b*	—	7	1398,1401,2917,2950	2,1
3994	Aquarius	η 62	4384		30.2	− 0	38	*VI.b*	—	4	2882,3076,6277,6390	2,1
4002	Cepheus	31	*1049*		33.2	+73	7	*XI.*	81	2	835, 839	1
4001	Lacerta	9	*3770*		33.2	+51	1	X.*a*, *b*	179	2	2466,2472	1
4007	Pisc. Aus.	ε 18	16010		35.1	−27	34	*VI.ab*	—	3	2971,3013,6001	2,1
4013	Pegasus	ζ 42	4797		36.4	+10	19	VI.*ab*	2	6	1349,2016,2071,2307	2,1

H. P.	Constellation.	B. Fl.	D.M.	R. A. 1900.	Dec. 1900.	Group.	Remark.	No. of Pls.	Plate Number.	No. of Dispersions.
				h. m.	° ′					
4015	Pegasus	o 43	4436	22 37.0	+28 48	VIII.*a*	62	1	1646	1
4020	Pegasus	η 44	4741	38.3	+29 42	XIV.*a*	97	1	1646	1
4024	Pegasus	ξ 46	4875	41.6	+11 40	XII.*a*	—	1	1370	1
4026	Pegasus	λ 47	*4709*	41.7	+23 3	XV.*a*	—	2	2103,2117	1
4031	Aquarius	τ 71	6354	44.3	−14 7	XVI.*a*	—	2	786, 828	1
4034	Pegasus	μ 48	*4615*	45.2	+24 5	XV.*a*	184	1	1362	1
4037	Cepheus	ι 32	1814	46.1	+65 41	XV.*a*	119	1	1392	1
4040	Aquarius	λ 73	5968	47.4	− 8 7	XVII.*a*	2	3	776,1411,3070	1
4047	Aquarius	δ 76	6173	49.3	−16 21	IX.*a*, *b*	32,177	2	2965,3067	1
4057	Pisc. Aus.	α 24	19370	52.1	−30 9	IX.*ab*	177	6	663,1542,1546,2027	4,2,1
4073	Androm.	o 1	4664	57.3	+41 47	V.*C.*	156	7	2481,2901,2916,2930	2,1
4076	Androm.	2	*4665*	58.0	+42 13	IX.*a*, *b*	178	6	2481,2901,2916,5956	2,1
—	Cassiop.	—	2629	58.3	+59 18	IV.*a*, *b*	20	1	1668	1
4078	Pegasus	β 53	4480	58.9	+27 32	XVIII.*a*	2	3	769,1552,2228	4,3,1
4080	Pegasus	α 54	4926	59.8	+14 40	VIII.*b*	32,64	6	629,1366,1502,6030	4,2
4086	Cassiop.	1	2545	23 2.4	+58 53	II.*a*, *b*	10	1	1668	1
—	Cassiop.	—	*2546*	3.0	+59 13	IV.*a*, *b*	—	1	1668	1
4093	Aquarius	c^2 88	6368	4.1	−21 43	XV.*a*	—	1	1365	1
4099	Cassiop.	2	2552	5.4	+58 47	IX.*a*, *b*	177	1	1668	1
4104	Androm.	7	3964	8.0	+48 51	XI.*a*, *b*	182	1	2923	1
4114	Pisces	γ 6	4648	12.0	+ 2 44	XV.*a*	32,184	1	1635	1
4120	Androm.	8	3991	13.1	+48 28	XVIII.*a*	65	1	2923	1
4139	Aquarius	b^1 98	6587	17.7	−20 39	XV.*a*	—	1	1598	1
4145	Aquarius	b^2 99	6420	20.8	−21 12	XVI.*a*	—	1	1598	1
4153	Cassiop.	—	2748	25.4	+57 59	IV.*b*	—	4	861,3857,3873,6906	2,1
4174	Androm.	λ 16	4283	32.6	+45 56	XV.*a*	112,184	1	1636	1
4182	Cepheus	γ 35	*928*	35.2	+77 4	XV.*a*	185	1	840	1
4198	Pisces	19	4709	41.3	+ 2 56	XXI.	137	4	1591,2122,2208,2210	1
4217	Pegasus	φ 81	5231	47.4	+18 34	XVIII.*a*	—	1	3007	1
4224	Cassiop.	ρ 7	3111	49.4	+56 57	XIII.*c*	—	2	2396,6992	1
—	Cassiop.	—	3115	50.5	+56 53	II.*P.*	14	2	2396,6992	1
4234	Cassiop.	R	4202	53.4	+50 50	XX.*a*	133	2	2206,2207	1
4238	Pisces	ω 28	5227	54.2	+ 6 18	XII.*a*	—	1	1415	1
4247	Pisces	30	6345	56.8	− 6 35	XVIII.*a*	—	1	3071	1

Table XIII., as stated on page 106, gives for each star in Table XII., whose spectrum was examined on more than four plates, the number taken from the Harvard Photometry, and the numbers designating the additional plates. When a star does not occur in that catalogue, it is readily identified by referring to Table XII.

According to Flamsteed the stars H. P. 155, 2595, 2601, 2849, and 2852 are in the constellations Ursæ Minor, Libra, Libra, Ophiuchus, and Ophiuchus respectively.

TABLE XIII.

ADDITIONAL PLATE NUMBERS.

Star.	Plate Number.	Star.	Plate Number.	Star.	Plate Number.
5	2097,2102,5094,5104,6201	936	1800,3016,3052,3104,4016,	*1823*	5526
9	5101,5170,6206,6271		4035,6106,6156	1923	5484
94	5192,6045,6124,6272	979	6508,6565	1949	1944,2359,2523,5497,6491,
142	2227,2294,4350,4376,5125,	978	5147		6629
	5189	1023	1688	1951	6523,6562
185	1373,2217,3081,5108,5232,	1024	1688	1965	6749
	5241,6031,6303	1026	1688	2025	6427,6459,6492,6532
213	2446,5145,5151	1029	6381	2036	5514
324	5166,5217,5254,6261,6498,	*1045*	6434,6616	2124	5202,5290,5271,5400,5491
	6509	1068	6084	2135	4791,4808,4821,4877,4891,
333	5184,6203	1091	1493,1504,1675,2201,6395,		4908,4927,4971,4988,5009,
336	6182,6231		6423,6566		5021,5038,5043,5047,5271,
356	6402	1100	2280,2302,2303,2349,2411,		5290,5342,5400,5422,5466,
361	6402		3250,3274,3282,3289,4396		5539,5548,5592,5600,5603
370	1419,1420,1432,1441,1452,	1104	6314,6401,6444,6457,6473,	2141	4656,5202,5271,5290,5400
	1480,1522,1572,1614,2123,		6628	2191	2849,3742,4836,4841,6475,
	2839,2852	1160	3105		6514,6569,6623
445	7020,7037	1201	6382,6424,6584	2263	516, 523, 550,1205,2611,
482	5248,6193	*1220*	4306,4347,4379,4461,4479,		2705,2710,2717,2721,2729,
489	2218		4512		3709,3719,6460,6493,6570
496	783, 784, 966, 973, 974,	1249	6400,6437,6474	*2264*	1748,2285,2287,2291,3712,
	1049,1050,1051,1060,1061,	1256	755,4307,4397,4454,4470,		6000
	1069		4506,4531	2267	4594,6000,6631,6668
516	4505,5161,5239,5381,5385,	1275	1708,1728,1775,3074,6092,	2338	6515
	5430,5464,5496,6118,6321,		6302	2381	6191,6218
	6405,6520	1295	3195,3206	2400	1200,1201,1241,1248,1259,
541	2257,5207,5257,6208	1311	834		1810,2650,6494,6563,6886
550	6408,6461,6564	1325	6488	2436	6621
551	6081,6194	1350	2596,4568,5421,6308,6425	2467	1273,1998,6625,6773,6798
554	6397,6408,6564	1399	6489,6513	2468	6785
555	5257,6254	*1423*	5285	2480	3714
578	4394,4458,4478	1442	5399,6309	2500	6842
665	6273	1459	5289,6256	2506	2794,6778,6789
797	1535,1584,1600,1673,1698,	—	3121,5129,5133	2510	1568
	2187,5258,6034,6195,6306	—	2534,5129,5133	2566	2680
862	6204,6217	1588	6468,6522,6679	2572	6859
877	2416,4564	1636	6295	2594	6622,6801
879	2527,6495,6500,6511,6524	1645	5427,6147,6619,6680	2625	6731,6732
—	6511,6524	1676	6641	2627	6642
896	6495,6500	1698	2597,5431	2638	2831,6804,6848
932	1440,2229,2237,2241,2343,	1797	500, 515,1110,1268,2528,	2645	2749,2788,2927
	4194,5256,6076,6190		5465,6359,6385,6390	2671	6818

Star.	Plate Number.	Star.	Plate Number.	Star.	Plate Number.
2690	6779	3260	3043,3060,5981,6861	3739	2803
2713	6872	3321	6918	3747	4345,4366,4924,4933,4992,
2764	1275,1278,2642,2772,2825	3419	2725,2727		5001,5007,5018,5027,5031,
2787	6741	3421	2928		5040,5045,5051,5058,5060,
2844	6805,6860	3424	2894,2928		5077,5080,5100,5103,5144,
2868	6829	3429	584, 655,1485,1946,1974,		5150
2879	3797,3897,4587		1983,2292,5995,6049	3750	6991,6993,6994
2880	6126,6226	3434	6354,6387	3836	6028,6166,6931
2944	6739,6776	3436	1430,1445,1446,1451,1471	3845	3080
3009	6751,6802,6843	3515	6915	3950	6228
3048	3027,5886	3527	2144	3960	4979,5023,5042,5046,5053,
3120	6197,6227,6259	3528	2039,2144		5067,5164,5187
3147	790,1494,2810	3541	2039,2144	3987	5972,6063,6088
3193	3772,3777,3786,3793,3796,	3547	4923,5006,5022,5032,5168	4013	5722,5988
	3839,3872,4862,4928,4932,	3564	2678,5889	4057	2941,5982
	4950,4964,4970	3624	6041,6174	4073	5956,6053,6074
3199	5858	3631	1511,1533,1984,4837,5929,	4076	6053,6074
3232	6059		6042	4080	6141,6167
3259	6108,6844	3647	6021,6889		

SUPPLEMENTARY NOTES.

1. Since the recent discovery of helium, the principal lines of that element have been identified by Vogel with lines in the spectra of stars of the Orion type. (Astrophysical Journal, Vol. II., page 333.) Table XIV. contains a comparison of the lines of helium with those already found in this investigation in the first six groups of stars of the Orion type, and in five of the principal stars of the same type but having bright lines in their spectra. The first and second columns give the wave length and intensity of helium lines as published by Runge and Paschen. (Astrophysical Journal, Vol. III., page 4.) All the helium lines are included whose wave lengths are between 3540 and 5050, and whose intensity is one or more, and also four of less intensity with which Orion lines appear to coincide. The series to which each line belongs is indicated by letters in the third column. The principal series of helium, the two subordinate series, and the three corresponding series of parhelium, are indicated by the letters a, b, c, d, e, and f, respectively. The fourth, sixth, and seventh columns are, with the exceptions mentioned below, copied from the second, fourth, and sixth columns respectively of Table IV. of this volume. The lines 3546, 3613, and 5045 have been subsequently determined by interpolation, although two of them, 3613 and 5045,

TABLE XIV.

HELIUM AND ORION LINES.

Helium.			Orion Lines.								
λ	Int.	Ser.	λ	I.	II.	III.	IV.	V.	VI.	Div. *c*.	γ φ π β P
3554.59	1	b	3546	.	.	.	3	.	.		
3587.43	2	b	3584	.	6	.	6	.	.		
3613.78	3	d	3613	.	3	.	3	.	.		
3634.39	2	b	3634	.	6	.	6	.	0		
3652.12	1	c	. . . .	.	0	.	0	.	0		
3705.15	3	b	3705	.	.	.	.	.	.		
3733.00	1	c	. . . .	.	.	.	.	.	.		
3785.03	<1	e	3784.6	p	1	1	1	0	0	. .	
3805.90	<1	e	3805.1	0	1	2	3	0	0	. . .	
3819.75	4	b	3819.2	p	10	13	13	6	3	. . . . .	. . . : :
3867.61	2	c	3867.6	p	1	1	2	1	1	. . .	.
3871.95	<1	e	3872.4	0	0	1	2	1	1	. .	
3878.33	<1	f	3876.4	0	0	1	1	0	0		
3888.78	10	a	3889	.	.	.	.	.	.		: :
3926.68	1	e	3927.1	0	1	1	4	2	0	. . .	. . . .
3964.88	4	d	3964.6	0	2	3	4	0	0	. . .	. .
4009.42	1	e	4009.5	w	2	6	7	3	1	. . . .	. . . . . .
4026.34	5	b	4026.4	p	10	12	12	6	5	. . . . .	. . . : :
4120.97	3	c	4120.5	w	3	7	4	2	2	. . . . .	. . . : :
4143.92	2	e	4144.0	w	3	7	8	4	2	. . . . .	. . . : .
4169.13	1	f	4169.2	0	0	1	2	0	0	. .	
4388.10	3	e	4387.8	w	3	7	8	4	1	. . . .	. . . : .
4437.72	1	f	4437.9	0	0	1	2	0	0	. . .	
4471.65	6	b	4471.8	p	10	11	12	5	4	. . . . .	. . . : :
4713.25	3	c	4712.8	p	2	2	2	1	1	. . .	. . . : :
4922.10	4	e	4925.7	p	4	6	6	3	1	. . . .	: : :
5015.73	6	d	5023	.	1	1	1	.	1	. . . .	: : :
5047.82	2	f	5045	.	1	?	1	.	.		:

had been previously recorded as faint lines. The wave lengths of the helium lines 3705.15 and 3888.78, the former always and the latter generally inseparable from the lines of hydrogen, have not been independently determined. The lines of helium present in Group I., Division *b*, are given in the fifth column. As no numerical estimates were made of the intensities of lines in Division *b*, the letter p has been used to indicate that a line is present with approximately the same intensity as in Group II., Division *a*, w to denote that it is weaker, and a zero that it is absent. The material for this column is that given in the first vertical row of the fifth column of Table IV., as modified by statements in regard to the comparative intensity of these lines found in the descriptions of Groups I. and II., pages 15 and 16 of this volume. The presence of helium lines in the first five stars of Table XI., γ Cassiopeiæ, ϕ Persei, π Aquarii, β Lyræ, and P Cygni, is indicated by dots in the last column of the table. When the lines are accompanied by bright-bands, a colon is substituted for a dot. In γ Cassiopeiæ fine bright bands are suspected, lying centrally upon the dark Orion lines 4026.4, 4387.8, and 4144.0, and possibly on 4471.8 and 4009.5.

From this table it appears that, with the exception of 3652.12, which is not very intense and occurs in a part of the spectrum photographed with difficulty, and of 3733.00, which is concealed by the hydrogen line Hλ, all the lines of helium and parhelium having intensity 1 or greater, are represented in Orion type stars.

In the case of the Orion lines 3546, 3584, 3876.4, 4925.7, 5023, and 5045, the agreement is doubtful. With the exception, however, of 3876.4, the wave lengths of these lines could not be obtained with accuracy, since they lie near the limits of the photographic spectrum where no standard lines of reference are to be found. Hence it appears probable that they may be lines of helium, notwithstanding the discordance.

It further appears that all the series of both helium and parhelium are represented, and that nearly all the lines of the first subordinate series of both helium and parhelium, as well as some lines of other series, reach a maximum intensity in Group IV., are very strong in Group III., and fall off more rapidly from this maximum toward the first type stars (Group VII.) than toward the beginning of the series. This fact, when the more precise behavior of the spectrum of helium under varying conditions of temperature and pressure has been investigated, may furnish a clue to the physical condition of the atmospheres of these stars. The coincidence, at the same point in the series of stellar spectra, of the disappearance of these helium lines with the earliest appearance of solar lines, is in this connection a fact of much interest.

An important exception to the above mentioned rule for the maxima of lines of the two first subordinate series is found in line 3705.15. The presence of this line in combination with Hξ, λ 3704.0, is inferred from the unusually great intensity of the latter line, which is the last line of hydrogen appearing in photographs of stars of the first four groups. In the first three groups the intensity of Hξ is decidedly greater than that of Hν and Hμ; in the fourth, it exceeds the first of these lines only, while in the fifth and sixth it falls below both. Since it is the rule that at the close of the hydrogen spectrum each successive line of shorter wave length diminishes in intensity, it is inferred that the helium line 3705.15 is here combined with Hξ, 3704.0; that it is strong in the first three groups, declines in the fourth, and is absent in the later groups of the series.

The distribution of helium lines in stars of Division *b* is essentially the same as in those of Division *a*, except that the prominent line of the principal series of parhelium, 3964.88, the only line of this series commonly included in the photographic spectra, is generally absent in stars of Division *b*. It was, however, found in stars of Group III. of this Division. As is the case with stellar lines in general, the fainter lines of helium may become invisible in Division *b*, owing to the haziness of the spectra.

In Division *c* the relative intensity of the helium lines to one another does not differ appreciably from that found in Division *a*, except in the case of line 3805.90, where it is greater in Division *c*. The helium lines as a whole, however, are more clear and conspicuous in Division *c*, and are far more persistent. They commonly remain present in from one to three groups beyond that in which they disappear in Division *a*. This may be seen from the seventh column of Table XIV., and from the added statement that the lines 4471.65 and 3819.75 are present in Group VIII., Division *c*. This greater persistence of the lines of helium, in connection with the greater intensity of calcium lines and the marked narrowness of the lines of hydrogen characterizing Division *c*, may some day furnish a clue to the difference of physical conditions in stars of Divisions *a* and *c*. It will further be seen that most of the stronger lines of both helium and parhelium were present in all five of the stars having bright lines in their spectra, though the lines of the second subordinate series of parhelium in the region having wave length shorter than 4860 were, perhaps owing to faintness, not seen in any of the five. The only line of the principal series of parhelium lying in the same region, 3964.88, was not seen in the first three stars, and the only line of the principal series of helium found in the entire photographic spectrum 3888.78 was undetermined in the first three, owing, as in the case of the normal stars, to its coincidence with $H\zeta$.

The aspect of these two lines of the principal spectra of helium and parhelium in β Lyræ and P Cygni is singular, and worthy of consideration. In β Lyræ, at the time of second maximum, when the two component spectra are most widely separated, a strong line, recorded as the "displaced $H\zeta$," is seen lying far to the violet of the true $H\zeta$ of hydrogen, being widely separated from it even under the dispersion of a single prism. (See page 103.) Though there is little doubt that this line belongs to the component of β Lyræ, whose lines at this period lie toward the violet, yet the wide separation observed could not be chiefly due to the separation of the component spectra, since this was only made visible by twice the dispersion, no other lines beside $H\zeta$ appearing double in plates taken with a single prism. Nor could the separation be perceptibly increased by the difference in wave length

0.23 ten-millionths of a millimeter between the hydrogen and helium lines, much greater differences being altogether imperceptible with one prism. It therefore appears probable that the displacement of the helium line is real. This opinion is confirmed by the fact that an apparent displacement of Hζ was recorded in P Cygni, although in that star the spectral lines do not become double. In P Cygni, as in β Lyræ, the line Hζ is accompanied by a strong bright band, and it can hardly be doubted that the marked reversal is in part, and the observed displacement wholly, due to the helium line in question. The wave length of the other line, 3964.88, appeared to be so much diminished that its identification was doubted. This line, though having greater intensity than in the normal stars of Orion type, is not reversed in either β Lyræ or P Cygni. A marked decrease in the intensity of this line during the change of phase of β Lyræ from principal to secondary minimum is, however, recorded in a previous study of this star. The line 3888.78 is in both P Cygni and β Lyræ accompanied by a very conspicuous bright band. This however, in P Cygni at least, is probably due in part to a bright band accompanying Hζ, with which the helium line is combined.

It will further be seen from the table that in β Lyræ and P Cygni most of the helium lines are accompanied by bright bands. These are for the most part quite conspicuous, and constitute with those of hydrogen the majority of bright bands present in these stars. These bands in P Cygni lie on the side of greater wave length of the dark lines, while in β Lyræ their position varies with the phases of the star. In P Cygni no reversal has been detected in the lines of the first subordinate series of parhelium having wave length shorter than 4860.

In γ Cassiopeiæ the reversal is not marked except in lines having wave length greater than 4860. A partial reversal is however, as previously stated, suspected in the lines 4026.34, 4388.10, 4143.92, and perhaps also in 4471.65 and 4009.42. These lines under the dispersion of four prisms appear very wide and hazy, and indistinctly double. This appearance, if confirmed, would indicate the presence of fine central bright lines similar to the central bright bands on the lines of hydrogen, but of less width and intensity. The reversal clearly seen in the helium lines 5015.73 and 5047.82 in γ Cassiopeiæ, and the well known reversal of D_3, render such additional reversals probable.

The stars ϕ Persei and π Aquarii, owing to their faintness, could not be photographed under sufficient dispersion to render visible such fine bright central bands, but the line 4922.10 appeared with a bright border in the first of these stars.

2. As regards the line 4144.0 mentioned in the text as possibly common to the Orion and solar systems of stellar lines, it may here be said that, since the line

found in Orion type stars is without doubt identical with the helium line 4143.92, it is evidently not solar, but is at some point in the series, perhaps in Group VII., replaced by the lines of the solar band within which it falls.

3. In connection with stars of the Orion type having bright lines it may be added that all the stars in Table XI. have been found by Campbell to have H*α* bright, and that in his opinion this line is bright in all stars having the line H*β* bright. (Astrophysical Journal, II. 177.) It is also a matter of interest that as the bright H*α* was found to have greater intensity than H*β*, the intensity of the bright lines in the spectrum of hydrogen in these stars diminishes in each successive line of shorter wave length. The contrast between this relation found in stars of the Orion type, where hydrogen emission lines occur, and that found in long period variables of Type III., like *o* Ceti, where the maximum intensity lies in the bright H*δ* declining in either direction, is interesting in connection with the discovery made by Professor J. J. Thomson, that when hydrogen is negatively electrified H*α* is brighter than H*β*, while when it is positively electrified the relative intensities are reversed. (Proc. Roy. Soc., Vol. LVIII. No. 350.)

The star *η* Tauri, which in this classification has been taken as the typical star of Group V., Division *a*, by Campbell's discovery that H*α* is bright, is removed to the class of stars in Table XI. of Orion type having bright lines.

4. In connection with Remark 166, page 102, on *β* Lyræ, it is interesting to note that the spectrum of this star at the time when the dark lines become widely double has been resolved by Lockyer into two component spectra, one of which resembles that of *β* Orionis, the other that of *γ* Orionis. This result agrees nearly with that independently arrived at here (see Remark 166), that one of the component spectra is of Group VII., Division *c*, approaching Group VI., Division *c*, the other of Group IV. In the present classification *β* Orionis is of Group VI., Division *c*, and *γ* Orionis of Group IV., Division *a*. (Monthly Notices, Vol. LV. p. 250.)

5. The double reversals observed in the hydrogen lines of *γ* Cassiopeiæ, *ϕ* Persei, (see Remarks 162, 163,) and other stars of the Orion type having bright lines, and the hazily triple character of the dark lines when the emission bands are faint, are facts of interest in connection with Jewell's discovery of complex reversals in lines of the solar spectrum, and his theory in regard to them. (See Astrophysical Journal, Vol. III. p. 89.) The dark borders found on the edge of greater wave length of the bright bands of P Cygni in photographs where the dispersion used was not sufficient to obliterate them by loss of contrast, and the similar border sometimes seen on the line H*β* of *β* Lyræ, and perhaps also the anomalous lines accompany-

ing Hδ and Hε in ν Sagittarii, are phenomena of the same order. (See Remarks 165, 166, 167.) The temporary disappearance of a line 3719.801 in the solar spectrum observed by Jewell may further be mentioned in connection with similar phenomena described in the remarks on various Orion type stars having bright lines. The occasional obliteration of the line Hγ in one of the components of the double spectrum of β Lyræ, and the total absence of Hβ in one photograph of ν Sagittarii, are instances in question. The indistinctness or invisibility of one or other component of certain of the triple lines of hydrogen in 11 Monocerotis and κ Draconis (see Remarks 170, 171), and the absence in γ Cassiopeiæ and φ Persei of the component of shortest wave length of the line Hκ (see Remarks 162, 163), while all the neighboring lines of hydrogen are triple, are further facts of which the explanation is as yet not clear, but which must have an important bearing on questions of molecular physics.

6. The star ζ Cephei should be inserted on page 90 in Group XV., Division *a*, with the Remarks 2 and 185.

7. A recent photograph of ν Hydræ, H. P. 1893, classified in the Tables as of Group XVII., shows it to be a star of Group XV., Division *a*, resembling α Cassiopeiæ. See Remark 125, page 98.

END OF VOLUME XXVIII., PART I.

ANNALS

OF

THE ASTRONOMICAL OBSERVATORY OF HARVARD COLLEGE

VOL. XXVIII.—PART II

SPECTRA OF BRIGHT SOUTHERN STARS

PHOTOGRAPHED WITH THE 13-INCH BOYDEN TELESCOPE

AS A PART OF

THE HENRY DRAPER MEMORIAL

AND DISCUSSED BY

ANNIE J. CANNON

UNDER THE DIRECTION OF

EDWARD C. PICKERING
DIRECTOR OF THE OBSERVATORY

CAMBRIDGE
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INTRODUCTORY NOTE.

THE first general classification of photographic spectra was made by Mrs. Fleming in the Draper Catalogue contained in Volume XXVII of these Annals. A detailed study of the photographic spectra of the bright stars visible in Cambridge has been made by Miss Maury, and is contained in Part I of the present volume. A similar discussion of the southern stars has been made by Miss Annie J. Cannon and is given below. In all three cases, it was deemed best that the observer should place together all stars having similar spectra and thus form an arbitrary classification rather than be hampered by any preconceived theoretical ideas, or by the previous study of visual spectra by other astronomers. If spectra which are absolutely identical can be placed together it makes but little difference what name is assigned to them, since in any future classification it is only necessary to take one star of each class and arrange them in any order, or give to them any nomenclature that may be desired. In forming the Draper Catalogue, the dispersion was small and but few divisions could be made, as slight differences could not be distinguished, although in the extension of this work to the South Pole, and the revision of the northern regions, several subdivisions of these classes were introduced. With the larger dispersion used in the later work, however, many differences became perceptible, and the northern stars were divided by Miss Maury into twenty-two classes, which were closely connected with one another, so that almost all the stars could be arranged in a single sequence with nearly imperceptible gradations. Miss Cannon, however, when studying the southern stars with a large dispersion found that they could be more conveniently designated according to the notation of the Draper Catalogue, modifying it so that intermediate classes of spectra could be indicated. The comparison made on page 145 shows how easy it is to pass from one system of notation to the other, and that so long as we have an accurate classification, the nomenclature is of little importance. It is believed that the present volume will furnish the principal facts regarding the spectra of all the brighter stars from the North to the South Pole, so that the reader can classify them according to any system he may choose, without the necessity of referring to the spectra themselves in each particular case. This is well shown by the comparisons made on pages 10 and 145. In the preparation of the present volume for the printer and in seeing it through the press, important aid has been rendered by Mrs. Fleming.

EDWARD C. PICKERING,
Director of the Observatory of Harvard College.

CAMBRIDGE, U. S., *April 12, 1900.*

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SPECTRA OF BRIGHT SOUTHERN STARS.

CHAPTER X.

OUTLINE OF CLASSIFICATION.

THE following pages contain a classification of 1,122 stars by means of their photographic spectra. These spectra have been examined on 5,961 plates photographed at Arequipa, Peru, with the Boyden telescope of this Observatory. The first plate was taken on November 29, 1891, the last on December 6, 1899. The telescope has an aperture of 13 inches (33 cm.), and a focal length of 16 feet (192 cm.). The photographs of the spectra were made by placing one, two, or three prisms in front of the object glass. The dispersion of the prisms is such that the spectra measure from Hϵ to Hβ, 2.24, 4.86, and 7.43 cm., for one, two, and three prisms, respectively. An appreciable width, generally not less than 0.5 cm. but varying according to the magnitude of the star, was given to the spectra by attaching different weights to the pendulum of the clock controlling the motion of the telescope. The time of exposure was generally about one hour. The stars classified include, first, all those south of —30° in declination whose photometric magnitude is 5.00 or brighter; second, numerous fainter stars south of —30° in declination; third, numerous stars whose declinations are included between 0° and —30°; fourth, a few northern stars.

The series of plates taken with the 13-inch Boyden telescope is designated by the letter X. All photographs of stellar spectra were taken from this series, and arranged in boxes according to the type of each spectrum following the classification of the Draper Catalogue. In cases where a plate showed more than one spectrum, the brightest only was considered in this preliminary examination. Thus, all plates on which the spectrum, or the brightest spectrum, was of the first type with the Orion lines present, were placed together and marked "B." In like manner those whose spectra were of the first type without Orion lines were marked "A"; those whose spectra appeared intermediate between the first and the second types were marked "F"; those whose spectra were of the second type were marked "G"; those whose spectra were of the third type showing sudden changes in intensity at the end of greater wave length were marked "M"; and, lastly, all those having bright lines were marked "Bright Line Stars."

The detailed study of spectra of the second type was first undertaken. The spectra of α Aurigæ, α Boötis, and α Tauri were assumed as examples of the subdivisions of this type. These three spectra were carefully studied and their differences noted. The plates marked "G" were then examined one by one. Each plate was placed on a stand and inclined at an angle of 45°. The light of the sky was reflected through it by means of a horizontal mirror. The spectrum was compared with the three typical spectra, and the plate was then superposed film to film on that which it most nearly resembled, so that the ends of the lines coincided. A positive eye-piece having a focal length of two inches was used in this examination. A record was made of the number and quality of the plate, the number of prisms used, the name or catalogue number of the star, the name of the typical star it resembled, and remarks were recorded concerning peculiarities, in cases where the spectrum differed from that of the typical star of the class. The same method of examination was later extended to the other spectra in the following order: "M," "F," "A," "B," "Bright Line Stars." After the general classification was outlined, a detailed study of the lines of each typical star and of each peculiar star was made.

It may be well at this point to describe the terms here used in referring to lines, or series of lines. The term "hydrogen lines" is used to designate the well known series of lines due to hydrogen, and designated Hα, Hβ, Hγ, Hδ, Hε, Hζ, Hη, Hθ, Hι, Hκ, Hλ, Hμ, Hν, Hξ, Hο, Hπ, Hρ, Hσ, Hτ, and Hυ. Any one of these lines is referred to as Hβ, Hγ, etc. The term "additional hydrogen lines" is used to designate the secondary series of lines due to hydrogen, first identified in the spectrum of ζ Puppis. In the following tables these lines are called Hβ′, Hγ′, Hδ′, Hε′, Hζ′, Hη′, and Hθ′. The term "Orion lines" is used to designate all the dark lines, except those due to hydrogen and calcium, in the spectra of classes Oe, Oe 5 B, B, B 1 A, B 2 A, B 3 A, and B 5 A. A list of these lines, as well as those due to hydrogen and calcium, is given in Table XXIII. Three of the lines included in this table, besides those of hydrogen and calcium, are common to the spectra of Class A. These are the double line, 4128.5 and 4131.4, due to silicon, and the magnesium line 4481.4. The Orion lines may be divided into two general classes, — first, those due to helium and parhelium; and, second, those due to other gases or substances. The term "helium lines" is used to refer to those lines which have been identified with helium or parhelium, a list of which is published on page 123 of this volume. Some of the Orion lines not due to helium or parhelium have recently been identified with oxygen and nitrogen. The triplet 4069.4, 4072.0, and 4075.9 is the most conspicuous of the lines due to oxygen seen in the photographic spectra of the stars. Lines 3994.9 and 4630.6 have been identified with nitrogen. The most intense Orion lines, not due to helium or parhelium, have not yet been certainly identified with any terrestrial element. Among them may be mentioned 4096.9, conspicuous in the spectra of Class Oe, and 4089.2, 4116.2, and 4649.2 conspicuous in the spectra of Class B. The term "solar lines" is used to designate the lines found in the spectrum of the Sun, excepting those due to hydrogen and calcium. Some of the solar lines are found in all the spectra from Class B 8 A to Class Mb. The term "calcium lines" is used to designate the lines or bands at wave lengths 3933.8 and 3968.6. The first of these lines is often called K, the second H. The term "band G" is sometimes used to denote the solar lines from wave length 4299.2 to 4315.2.

The identification of the lines forms an important part of a detailed classification of stars by means of their spectra. The hydrogen lines can be readily selected on plates of all dispersions in spectra of Class A. By superposing spectra of this type on spectra of other types taken with the same dispersion, the hydrogen lines, however faint, can be identified. The Orion lines were identified by means of Table IV, page 53, of this volume. The more intense lines, as those at wave lengths 3819.2, 4026.4, 4089.2, 4116.2, 4120.5, 4144.0, 4471.8, and 4649.2, were found by their relative positions with respect to the lines of hydrogen. The faint lines also could sometimes be identified from estimates of their position, with the aid of the wave lengths and intensities given in Table IV. This method could be employed for faint lines lying close to known intense lines, or situated in small spaces between two well marked lines. Frequently, however, measures were necessary to identify the faint lines. A scale divided into half millimetres was used, and small sections of the spectrum were measured at a time, — as, for instance, the portion of the spectrum between the Orion lines, 4387.8 and 4471.8. With the zero of the scale on the line 4387.8, measures of all the lines were made as far as 4471.8, inclusive, and their intensities estimated. Approximate wave lengths were obtained from these measures by interpolation or graphically. From these wave lengths it was generally easy to determine whether the lines measured corresponded with given lines in Table IV.

It was more difficult to identify the solar lines on any plate with those in Tables V and VI of Part I, than to identify the Orion lines with those in Table IV. For many parts of the spectrum, it was necessary first to identify the lines on a plate of the solar spectrum by a comparison with Rowland's map. No photograph of the solar spectrum having been taken with the Boyden telescope, a plate taken with the 11-inch Draper telescope with four prisms as described on page 2, was used. The solar lines in any portion of the spectrum on this plate were identified by a careful comparison of the corresponding region on Rowland's map, with the aid of the intensities given in Tables V and VI. The spectrum of α Aurigæ so nearly resembles that of the Sun, that by superposing the plate of the solar spectrum on one of α Aurigæ taken with three prisms, the lines in that star could be readily identified with the solar lines, allowance being made for the slightly different dispersions of the two plates. Lines once identified in the spectrum of α Aurigæ were easily found in other spectra by superposing plates of similar dispersion. Since the objective prism was used in photographing these spectra, and the field of view of the telescope is 8 inches in diameter, many of the plates show the spectra of several stars distinctly enough to permit them to be classified. These additional stars represent various types of spectra and therefore could not be classified until the systematic study of the brighter stars was completed. All these additional spectra were therefore identified and reserved for classification later.

When the spectrum of only one star appeared on a plate it was identified by the hour angle and setting in declination of the telescope, making a proper allowance for the deviations of the prisms used. In cases of doubt, a comparison was made with photographs of the same region taken with the Bache telescope. These photographs were also used to identify the fainter spectra when several appeared upon a plate. This work was facilitated by a series of manuscript charts on the scale of 2 cm. to 1°, and extending from declination —20° to the south pole. On these charts the positions for 1900 had been entered of all stars of the magnitude 7.0 and brighter in the Uranometria Argentina. Each spectrum was identified twice independently, once by Miss L. D. Wells and once by the writer.

Of the 1,122 stars classified from these plates, 41 have been photographed with three prisms, 268 with two prisms, and 813 with one only. The plates taken with one prism were found most useful in making the general classification, those with two or three prisms were found necessary for detailed study of peculiarities and intensities of lines.

Partly from the fact that so small a proportion of the total number of stars classified has been photographed with more than one prism, it was found inexpedient to make the divisions "a," "b," and "c" as given in Part I of this volume. There are doubtless great differences in the width and sharpness of the spectral lines. α Eridani of the Orion type, and α Aquilæ of the later first type, may be mentioned as having broad and hazy lines, while β Orionis of the Orion type and 1 Puppis of the first type have unusually well defined lines. The facts relating to the width of the lines are given in the remarks following Table XVI, and great care has been exercised to determine whether such variations from the normal are due to the star or to instrumental conditions. In cases where the lines of any spectrum appeared hazy, plates taken just before and after, on the same evening were examined to see if the lines on them were well defined at that time. If this was the case, and the lines were well defined on other plates of the same star taken on earlier dates, the star was regarded as an object of interest, and, as soon as practicable, a request was sent to Peru to have other photographs of it taken. It is well known that a poor adjustment of the focus will sometimes give lines that are distinctly double. For instance, in the spectrum of α Carinæ on Plate X 7897, all the lines are double. The spectrum of α Carinæ usually shows well defined lines, and the doubling of the lines on this plate would be remarkable except that on the preceding plate taken the same evening the lines are also double. The latter plate shows the spectrum of β Orionis. It is interesting to note in this connection that two stars which, from earlier plates, were classed among the spectra showing hazy lines, are proved by later plates to be spectroscopic binaries. These stars are π Scorpii and ζ Centauri.

The letters of the Draper Catalogue are used in the following discussion to denote the various classes of spectra. The relation between the letters of the Draper Catalogue and the five types in ordinary use for visual spectra is as follows: —

Type.	Letter.	Type.	Letter.
I	A, B	III	M
I–II	F	IV	N
II	G	V	O
II–III	K		

When the letters of the Draper Catalogue were adopted as the symbols of classification in this discussion, it was soon found that many subdivisions must be made to suit the varieties of spectra seen on plates of greater dispersion. Thus, the letter B is used in the Draper Catalogue to represent all the spectra showing the dark hydrogen lines together with the Orion lines, those at wave lengths 4026.4 and 4471.8 being, it is stated, the only lines commonly seen with the small dispersion employed. It is obvious, however, that the letter B can not represent all the varieties of spectra photographed with a dispersion which shows eighty or more Orion lines with many combinations of intensities, as on plates taken with three prisms. It was therefore decided that the letter B should be used to indicate stars of the Orion type in which some of the Orion lines are as intense as the hydrogen lines. The gradual decrease in the intensities of the Orion lines and the increase in the hydrogen lines were next made the basis of a series of subdivisions of Orion stars in which the interval between Class B and Class A is estimated in tenths. Thus the spectra of Class B 1 A are very nearly like those of Class B, while those called Class B 9 A show only slight differences from those of Class A. Those of Class B 5 A appear to be about midway between the two classes. The evidence that the Orion spectra precede the Sirian is as good as that the Sirian precede the solar. The gradual decrease in the intensities of the Orion lines is accompanied by gradual increase in the hydrogen lines, and by the incoming of faint solar lines, so that in spectra of Classes B 8 A and B 9 A, solar and Orion lines are commingled. Hence, it was necessary either to interchange the letters B and A of the Draper Catalogue or to place the letter B before the letter A. The first alternative would prove confusing. The second presents no real difficulties since the letters are merely symbols to express an observed condition.

The letter A in this classification represents spectra of the Sirian type, of which α Canis Majoris and α Lyræ are examples. These spectra may be defined as those in which the Orion lines in general are absent, the line K and the solar lines are faint, and the hydrogen lines are of great intensity.

The letter F represents spectra in which the wide bands of calcium, K and H, are the most conspicuous features, while the hydrogen lines are still more intense than any solar lines. The gradations of spectra found between Classes A and F are indicated by the combinations A 2 F, A 3 F, and A 5 F.

The letter G represents spectra of the characteristic solar type, of which α Aurigæ has been used as the best example. The spectra of Class G may be defined as those in which the lines K and H of calcium and the band G are the most conspicuous features, while the hydrogen lines are still as intense as any of the solar lines. Spectra intermediate between Classes F and G are indicated as F 2 G, F 5 G, and F 8 G. The letter K represents spectra of the later second type, or intermediate between the second and third types. The letter K may be briefly described as representing those spectra in which the bands K and H, the band G, and the line 4227.0 are the most conspicuous features, and in which the end of shorter wave length is faint, and the distribution of light is not uniform in different parts of the spectrum. The hydrogen lines in this class are fainter than numerous solar lines. Spectra intermediate between Classes G and K are designated by the letters G 5 K. The letter M represents, in general, the spectra which differ from those of Class K mainly in showing sudden diminutions in intensity as the wave length increases, at 4762, 4954, 5168, and 5445. Spectra coming between Classes K and M are indicated as K 2 M and K 5 M. Since no spectra were found which followed those of Class M, and into which this type of spectrum appeared to merge, the variations of these spectra could not be expressed in intervals between M and any other letter. The two divisions of stars of Class M are therefore indicated by the letters Ma and Mb. With the spectra of Class Mb, the series in which the various spectra merge almost insensibly from one type to another is concluded as far as it has been observed on these plates. The letters Md represent spectra of the third type showing one or more bright hydrogen lines. Spectra of the fourth type, for which the letter N is used in the Draper Catalogue, do not appear on any plates in the series examined for this classification. Thus, with the symbols B, A, F, G, K, Ma, and Mb, or with combinations of these symbols, and by the aid of remarks to explain the peculiarities of those spectra that vary slightly from the typical stars, all spectra with wholly dark lines can be provided for with one exception.

A few spectra of the Orion type were found which clearly precede those of the class called B. These spectra might have been called by the letter B, and those now called B passed on to B 1 A, and so on. But when it was found that these spectra were intermediate between a class of spectra showing bright lines and those of Class B, it was deemed advisable to express that fact in the symbol used to designate them. Stars of the fifth type are those whose spectra consist mainly of bright lines. The spectra of these stars are characterized by the bright bands at wave lengths 4633 and 4688, and the line at 5007 characteristic of gaseous nebulæ, is sometimes present. Stars whose spectra are of the fifth type are called O in the Draper Catalogue. In the present classification five subdivisions of Class O are represented by the letters Oa, Ob, Oc, Od, and Oe. These subdivisions depend upon the varying intensities of the bright bands named above, and the various combinations of these bands with other lines and bands, bright or dark. It is between spectra of Class Oe and Class B that the few spectra with wholly dark lines above referred to as falling outside of the series from B to Mb appear to belong. They are therefore designated by the symbol Oe 5 B. Spectra of Class Oe 5 B differ mainly from spectra of Class Oe in having line 4685.4 dark, and in the presence of the dark line 4649.2 instead of the bright band 4633; they also differ mainly from spectra of Class B in the greater intensities of the additional hydrogen lines, and of line 4685.4. These spectra, in combination with those of Class Oe, appear to establish the position of spectra of the fifth type as preceding those of the Orion type. The letter O has been placed, therefore, in this classification, before the letter B instead of after the letter M. The letter P represents the spectra of planetary nebulæ. The letter Q represents peculiar spectra having bright lines.

One other class of spectrum remains unprovided for, namely, the spectra of the Orion type with one or more bright hydrogen lines. The Orion lines in these spectra are found to conform more or less closely to one of the systems of Orion lines in the typical Orion spectra. Hence, in the absence of any connection between these spectra and others having bright lines, these spectra are regarded as peculiar objects, and are given in Table XVI under the class of stars which they would resemble were all the lines dark. A list of these stars in the order of right ascension is given in Table XIX. A few spectra were found which presented the combination of two distinct types so completely superposed that no separation either in right ascension or declination could be detected. These spectra are called composite. Five spectra showing lines periodically double were found in this series. Stars whose spectra show this peculiarity are called spectroscopic binaries. Lists of the stars having the above-named peculiarities of spectra are given in Tables XX and XXI.

As a result of this classification it is found that most of these 1,122 spectra can be arranged in a sequence. The spectra of Class Oe, or possibly those of Class Ob, are at one end of the sequence, while the spectra of Class Mb are at the other end. The order of the development is not indicated, and the series might proceed from Class Mb to Class Oe, instead of from Class Oe to Class Mb. The latter seems more probable, perhaps owing to its agreement with Laplace's theory of stellar development. The progressive changes in the spectra are at times so slight as to be almost imperceptible, and so gradual as to make exact differentiation difficult, while again the changes are somewhat abrupt, and it appears as if intermediate forms as yet undiscovered might exist. Commencing with Class Ob, the course of the development may be traced briefly as follows. Wide, hazy, bright bands that correspond to both series of hydrogen lines and two bright bands at wave lengths 4606 and 4688 are present. The hydrogen lines, and band 4688, become narrower, and band 4606 is replaced by a band having wave length 4633. The two series of hydrogen lines next appear dark, while the bands 4633 and 4688 are still bright, though of less width and intensity. As these two bands decrease in brightness, the helium and other Orion lines appear. Two well marked dark lines, 4649.2 and 4685.4, are present when the bright bands disappear. Line 4685.4 appears to be the reversal of at least a part of the bright band 4688. Lines 4649.2 and 4685.4, together with 4089.2, and 4116.2, none of which are due to helium or parhelium, become the most characteristic Orion lines, being as a whole more conspicuous than the helium lines. The additional hydrogen lines decrease in intensity until they become invisible when the helium lines are at their maximum intensity. Lines 4089.2, 4116.2, and 4649.2, decrease rapidly so that they are absent or inconspicuous when the helium lines are most intense. The helium lines remain visible longer than the other Orion lines and some of them are present in spectra showing also faint solar lines. The loss of the helium lines occurs when the hydrogen lines are at their maximum intensity. The solar lines and the calcium lines now increase rapidly, while there is a corresponding decrease in the hydrogen lines. The band G becomes conspicuous. The distribution of light is now unequal in different portions of the spectrum. Two distinct bright bands appear between $H\gamma$ and $H\beta$, and the spectrum towards the end of shorter wave length becomes so faint that the bands K and H are barely seen on plates of normal exposure. The calcium line 4227.0 becomes more conspicuous than band G. The spectrum becomes banded at the end of greater wave length, sudden changes in intensity taking place at wave lengths 4762, 4954, 5168 and 5445. These changes are at first only slightly marked, but later they become so abrupt as to be the most distinguishing feature of the spectrum.

The typical stars of each class have been selected so as to show as nearly as possible the continuous development of the series. Stars that differ from the typical stars are marked peculiar and discussed in the remarks. Peculiarities manifest themselves in five different ways. First, the width of the lines may be greater or less than in the typical star. Spectra having lines more or less broad and hazy were found in nearly all the classes of first type stars, and may be selected from Tables XVI or XVII by means of the common remark, number 18. Some spectra are also found in which the lines are narrow with sharp edges, often appearing peculiarly intense. These spectra may be distinguished by means of the remark common to all, number 40.

Second, the intensities of lines, or sets of lines, may differ from those in the typical star. A peculiar intensity of a certain line may appear in one spectrum only, but more generally, there are small groups of stars in which the same line or lines vary from the normal. These peculiarities may be found in several spectra of the same class, or may appear in peculiar spectra of several successive classes. A group of peculiar spectra of Class A, for instance, has the double line 4128.5 and 4131.4 especially well marked. These stars are υ Fornacis, τ^9 Eridani, α Doradus, L^1 Puppis and θ^2 Microscopii. Again, the peculiar spectra of θ^1 Microscopii, and ι Phœnicis of Class A 2 F, of δ Normæ of Class A 3 F, of ξ Phœnicis of Class F, and of ζ Capricorni of Class G, have the line 4077.9 unusually intense.

Third, certain lines may be reversed, partly reversed, or doubly reversed. In the first case, the line appears bright, as, for instance, Hδ or Hγ in Class Md. In the second case, the lines may be bright, and be superposed on dark bands as in the Orion spectra, having bright hydrogen lines; or Hβ may appear dark, superposed on a bright band, as in the spectrum of γ Velorum. In the third case, the line may appear as a dark band on which is superposed a bright line which itself has a dark thread centrally superposed, as Hγ or Hβ in the spectrum of α Aræ.

Fourth, the lines may be periodically double as in the case of the spectroscopic binaries.

Fifth, the spectrum may consist of two spectra of different classes completely superposed, as in ε Carinæ and other stars of the composite type.

Table XV shows the relation between the symbols employed to designate the spectra classified in Part I of this volume, and those employed in Part II. The first four columns give the group number, the division letter, the constellation, and designation of the typical star of each group of Part I, as taken from Table IX. The first star named in that table after each division letter of each group is considered a typical star. Stars of intermediate groups, but not those of intermediate divisions, are included. The typical star of group VIc is H. P. 551, of group XXII is H. P. 1311. The fifth column gives the class to which the spectrum belongs, according to the classification of Part II. The sixth column gives numbers referring to the remarks following Table XVI. In order to classify these spectra according to the system adopted in the following discussion, several plates of each typical star taken with the 11-inch Draper telescope were examined. They were the same plates that had previously been used for classifying these spectra in Part I. To make the classification independent of any knowledge of certain spectra, the plates were removed from the covers, the covers were laid aside, and the plates were then thoroughly intermingled. Since 21 of these typical stars are common to Parts I and II of this volume, this method gave a perfectly independent classification of these 21 stars, photographed at different times with different instrumental and atmospheric conditions. The classification was made by comparison with typical stars of Table XVI, allowance being made for the difference in dispersion. It will be seen that remark 18 of Part II corresponds generally to division "b" of Part I, and remark 40 corresponds to division "c." Slight differences may be accounted for by the quality of the photographs. For instance, the lines in the spectrum of ζ Canis Majoris are somewhat broad on the only photograph taken with the Draper telescope, but they are well defined on three plates taken in Peru with the Boyden telescope. Hence, remark 18 appears after the star in Table XV, but not in tables XVI and XVII.

TABLE XV.

SPECTRA OF TYPICAL STARS IN PART I.

Group.	Div.	Constellation.	Desig.	Class.	Remarks.	Group.	Div.	Constellation.	Desig.	Class.	Remarks.
I	*b*	Monoceros . .	S	Oe 5 B	18	VIII	*c*	Cygnus	α	A 2 F Pec.	40, 154
II	*a*	Orion	ε	B		IX	*b*	Ursa Major. .	δ	A 2 F	18
"	*b*	Orion	δ	"	18	X	*a*	Triangulum .	β	A 5 F	
III	*a*	Canis Major .	β	B 1 A		"	*b*	Aquila	α	"	18
"	*b*	Virgo	α	B 2 A	18	XI	*a, b*	Aquila	δ	F	
"	*c*	Orion	χ^2	"	40	XII	*a*	Canis Minor .	α	F 5 G	
IV	*a*	Orion	γ	"		"	*c*	Auriga	ε	" Pec.	40, 182
"	*b*	Ursa Major. .	η	B 3 A	18	*XII*	*c*	Cygnus	35	"	180
IV	*a*	Orion	π^4	"		XIII	*a*	Orion	χ^1	F 8 G	
"	*b*	Canis Major .	ζ	"	18	"	*c*	Canis Major .	δ	" Pec.	40, 185
V	*a*	Taurus	η	B 5 A		*XIII*	*a*	Perseus	θ	G	
"	*b*	Orion	τ	"		XIV	*a*	Auriga	α	"	
"	*c*	Canis Major .	η	" Pec.	40, 96	*XIV*	*a*	Gemini	κ	G 5 K	
VI	*a*	Perseus	β	B 8 A		XV	*a*	Boötes	α	K	
"	*b*	Leo	α	"	18	*XV*	*a*	Cancer	β	K 2 M	
"	*c*	Orion	β	" Pec.	40, 112	XVI	*a*	Taurus	α	K 5 M	
VI	*b*	Aquarius	η	"	18	XVII	*a*	Andromeda . .	β	Ma	
"	*c*	Camelop. . . .	—	B 9 A	40	XVIII	*a*	Orion	α	"	211
VII	*a*	Canis Major .	α	A		XIX	*a*	Perseus	ρ	Mb	
"	*b*	Hercules	ο	"	18	*XIX*	*a*	Hercules	α	"	214
"	*c*	Leo	η	" Pec.	40	XX	*a*	Cetus	ο	Md	
VIII	*a*	Gemini	α	"		XXI	—	Pisces	19	N	
"	*b*	Ursa Major. .	γ	"	18	XXII	—	Canis Major .	—	Ob	

CHAPTER XI.

Detailed Description of the Classification.

The following pages contain a more detailed description of the classes into which the spectra are divided, than is given in the preceding chapter. The spectrum of a typical star of each class is described, with the exception of Classes P, Q, and Md. Since the spectrum of only one gaseous nebula appears in this series of plates, it was deemed best to describe its spectrum in a remark rather than assume it to be typical of the class for which the letter P is used. The letter Q is used to designate peculiar spectra having bright lines. Since no spectrum of this class can be called typical, a description of each one is given in the remarks following Table XVI. Classes P and Q are placed first in the Table, because they appear to be more nearly related to the spectra of Class O than to those of any other class. Spectra of Class Md, or those of the third type having bright hydrogen lines, are regarded as peculiar, and a description of each of those photographed in this series, is given in the remarks.

Class Oa.

Typical star, — Carinæ, A. G. C. 15305.

The spectrum consists of bright bands on a faint continuous background.

Faint, indistinct, bright bands are present at 4101.8 and 4340.7, the wave lengths of the hydrogen lines Hδ and Hγ. The additional hydrogen lines, first found in ζ Puppis, are suspected to be present and bright, but they are not clearly seen in any photograph of the spectrum in this series. A faint bright band appears to coincide with the helium line, 4471.8.

A broad bright band whose centre is at the wave length 4633 is the most conspicuous feature of this spectrum. On the side of shorter wave length, the edge of this band is well defined and resembles a dark line; on the side of greater wave length, the brightness fades off into a fainter band of nearly equal width, which may coincide with band 4688 seen in Classes Ob, Oc, Od, and Oe. On X 4065, the brighter and fainter portions of the band are separated by a dark space, and resemble in position and relative intensity the bright bands in γ Velorum. A bright band is faintly seen at wave length 4059. The photographs of A. G. C. 22827, Z. C. 8^h 4141, and Z. C. 10^h 2684, show no bright bands except that at wave length 4633, but this is probably due to insufficient exposure, or faintness of the stars.

Class Ob.

Typical star, — Canis Majoris, A. G. C. 8631, H. P. 1311.

The image consists wholly of wide bright bands on a continuous spectrum, but differs essentially from the spectra of Class Oa in the intensities and positions of these bands. With the exception of 4633 in Class Oa, the width of the bands in A. G. C. 8631 exceeds that of any other bands, bright or dark, in any spectrum examined for this classification. The hydrogen lines Hε, Hδ, Hγ and Hβ are bright. The additional hydrogen lines at wave lengths 4026.0, 4200.7, and 4542.4 are also bright. No lines due to helium are seen.

The spectrum is especially characterized by the intensely bright band whose centre is at wave length 4688 approximately. On X 4115, taken June 1, 1892, with an exposure of 61^m, this band shows a narrow line, nearly central, which is brighter than the other portion of the band, and which appears to coincide in position with the dark line 4685.4 in the spectra of τ Canis Majoris and ε Orionis of Classes Oe 5 B and B. On X 4512, taken December 18, 1892, with an exposure of 64^m, the band 4688 shows a dark division, but having greater wave length than the line 4685.4, mentioned above. The other bands on X 4512 have the appearance of being double, except Hδ and Hγ, which are narrower and better defined than on the other plates. The next band of shorter wave length than 4688 has a centre at 4606, and does not coincide with the bright band 4633 of Classes Oc, Od, and Oe. A bright band at wave length 4059 is well marked. The wave lengths of the lines measured in this spectrum will be found in Table XXVIII.

No other spectrum like that of A. G. C. 8631 appears on the plates of this series, probably because these stars are too faint to be photographed with the dispersion here employed.

Class Oc.

Typical star, — Scorpii, A. G. C. 22763.

The spectrum resembles that of Class Ob in showing only bright lines or bands. The bands, however, are much narrower than in the former class, and there are important differences in the portion of the spectrum between Hγ and Hβ. The spectrum is photographed from about wave length 4027 to Hβ.

The hydrogen lines Hδ, Hγ, and Hβ are bright. They are not quite 0.5 as wide as in the spectrum of A. G. C. 8631, of Class Ob. The additional hydrogen lines having wave lengths 4026.0, 4200.7 and 4542.4 are bright.

A bright band, faintly seen, coincides with the helium line 4471.8. The helium line 4026.4, if present, is superposed on the additional hydrogen line 4026.0.

The bright band 4688, though not more than 0.3 as wide as in the spectrum of A. G. C. 8631, is still the most conspicuous feature of the image. The adjacent bright band has its centre at wave length 4633, and the two bands 4633 and 4688 resemble those of ζ Puppis, of Class Od, in position and relative intensity. A bright band between that at 4471.8 and the additional hydrogen line 4542.4 coincides with the line 4514.5, which is dark and well marked in Classes Oe and Oe 5 B. The line 4059 is bright, and more sharply defined than the other lines.

Class Od.

Typical star, ζ Puppis, A. G. C. 10691.

All lines are dark except the bands 4633 and 4688 which are bright. The dark lines are narrow and well defined and very few faint lines are present.

The hydrogen series is seen from Hλ to Hβ, and is wholly dark. The additional lines of hydrogen are also dark and more intense than in any spectrum so far photographed. Eight lines belonging to this new hydrogen series have been measured, and their wave lengths may be found in Circular No. 55. The helium line 4471.8 is present and dark, but faint. The presence of line 4026.4 is undetermined, owing to its proximity to the additional hydrogen line 4026.0.

The two bright bands 4633 and 4688 are less intense than in Class Oc. On plates taken with two prisms, the band 4688 is separated into two bright lines, of which that having greater wave length is four or five times as intense as that of shorter wave length. The band 4633 is not double. The calcium line, K, is dark and faint. On isochromatic plates no lines are seen of greater wave length than Hβ, except the additional hydrogen line 5414, and a faint line at wave length 5202.2. No other star has yet been found whose spectrum is exactly like that of ζ Puppis. It is considered a typical star because its spectrum comes between those of Classes Oc and Oe.

Class Oe.

Typical star, 29 Canis Majoris, A. G. C. 9311.

All lines are dark except the two bands 4633 and 4688 which are bright as in ζ Puppis, but unlike the spectrum of ζ Puppis in which only four dark lines were found besides those due to hydrogen, this spectrum shows numerous well marked dark lines.

The hydrogen lines are seen from Hθ to Hβ inclusive. Hβ is only 0.5 as intense as Hδ or Hγ, and is bright on the edge of greater wave length. The additional lines of hydrogen are present, but less intense than in ζ Puppis. The magnitude of this star is 4.77, and owing to its faintness, only the four additional hydrogen lines at wave lengths 3924.0, 4026.0, 4200.7, and 4542.4, have so far been photographed. The line 4542.4 is bright on the edge of greater wave length. The lines due to helium are nearly as numerous and well marked in spectra of this class as in the typical Orion stars. Table XIV, on page 123 of this volume, gives the wave lengths of the helium lines as published by Runge and Paschen, and their identification with Orion lines. According to the series explained on page 122, the following helium lines are contained in this spectrum between the limits 3798 and 4925. In series b, 3819.2, 4026.4, 4471.8; in series c, 4120.5, 4712.8; and in series e, 4144.0, 4387.8, and 4922.1. The helium line 4026.4 is not separated from the additional hydrogen line 4026.0, but the presence of the helium line is assured by the increased intensity of the line 4026.4 over the other additional hydrogen lines, as may be noted from the intensities given in the seventh column of Table XXII. The helium line 3867.6 may be present, although not detected on account of imperfect focus in that part of the spectrum. With the dispersion used, the helium line 3926.8, if present, is not separated from the additional hydrogen line 3924.0. The only line of the principal series of helium within the limits of the photographic spectrum has the wave length 3888.78. If present, it would be superposed upon the hydrogen line Hζ, wave length 3889.1. Since, however, no unusual intensity is observed in this hydrogen line, it cannot be assumed that the helium line is present.

While the helium lines in this spectrum connect it with the stars of Class B, the bright bands 4633 and 4688, although less intense, are present, as in ζ Puppis. The bright band 4633 is resolved into two faint lines of equal intensity, of which the one towards Hβ shows a dark edge on the side of greater wave length. This dark edge appears to coincide with the line 4649.2 in Classes Oe 5 B, B, B 1 A, and B 2 A. A dark line at wave length 4059 appears to be the reversal of the bright line or band seen in Classes Oa, Ob, and Oc.

In addition to the above named lines, the dark lines 4089.2, 4096.9, 4116.2, and 4514.5 are also present. 4089.2 is slightly bright on the edge of greater wave length. 4096.9 is so near Hδ, wave length 4101.8, that it gives the hydrogen line the appearance of being double, or of having a bright central line superposed on a broad dark line. By superposing this spectrum upon that of another star, it is easily seen that Hδ is not double. It then appears that Hδ of the superposed image matches the line of greater wave length in this spectrum, and the line 4096.9 is well separated from the hydrogen line. 4096.9 has not been seen in the preceding classes of spectra, and is strongest in spectra of this class, declining in intensity in succeeding classes until B 2 A is reached, when it is not present. The line 4514.5, which is dark in spectra of this class, is bright in Class Oc.

CLASS Oe 5 B.

Typical star, τ Canis Majoris, A. G. C. 9313.

All lines are dark. The bright bands 4633 and 4688 are not present. The spectrum resembles that of Class Oe in the intensities of the additional hydrogen lines, but is nearly like ε Orionis of Class B in the intensities of the helium lines. It thus appears to be intermediate between the spectra of stars showing the bright bands 4633 and 4688, and stars of the marked Orion type.

The hydrogen series is seen from Hμ to Hβ inclusive. Four lines of the additional hydrogen series are present, as in A. G. C. 9311 of Class Oe. The additional hydrogen line 3860.8 is suspected.

The lines due to helium which are present in Class Oe are also seen in this class of spectra, and several fainter lines, especially 3964.6 and 4009.5, are present, as in ε Orionis. The well marked dark line 4685.4 appears to be the reversal of a part at least of the bright band 4688. This line is seen only in this class, and in Classes B and B 1 A. The dark line 4649.2 is well marked. It appears at the extreme edge of greater wave length of the bright band 4633, present in Classes Oc, Od, and Oe. Lines 4089.2 and 4116.2 are more intense, while lines 4096.9 and 4514.5 are less intense than in Class Oe, thus showing an advance towards Class B. The calcium line K is sharply defined and more intense than in Class Oe or Class B.

CLASS B.

Typical star, ε Orionis, A. G. C. 6501.

All lines are dark. As seen with the dispersion of one prism, the spectrum differs from that of τ Canis Majoris of the preceding class, mainly in the diminished intensity of the additional hydrogen lines. An excellent plate, taken with three prisms, shows many fainter lines whose wave lengths and intensities are given in Table XXIII. This spectrum is specially characterized by the great intensity of several of the Orion lines, some of them being so well marked that the hydrogen series is not readily detected at first glance, as may be done in all the following classes of Orion stars.

The lines of hydrogen are nearly 0.3 as intense as in the spectrum of α Canis Majoris. The system is seen from Ho to $H\beta$. $H\xi$ is more intense than $H\nu$, but Ho is very faint. The additional hydrogen lines 4200.7, 4542.4, and 5414 are present. The presence of 3924.0 is undetermined, owing to haziness of the image in that region, and 4026.0, if present, is superposed on the helium line 4026.4. Line 5414 as photographed on the isochromatic plate X 8119, is more intense than 4200.7 or 4542.4. This plate also shows a dark line of intensity 2, on the scale of the intensities in Table XXIII, and having greater wave length than 5414. This line has been photographed only in the spectra of ε, ζ, and δ Orionis. By superposing the spectrum of ε Orionis on X 8109, α Aurigæ, this Orion line falls upon the solar band 5587.0 to 5589.6. Its approximate wave length is therefore 5588.

A table of the helium lines seen in this spectrum is given on page 123 of this volume. It is noted that all helium lines whose intensity is greater than 1, between the wave lengths 3584 and 5045, are found in this spectrum with the exception of lines 3705.15 and 3888.78, which, if present, are superposed on the hydrogen lines $H\xi$, 3704.0, and $H\zeta$, 3889.1, respectively. Their presence, therefore, could not be detected save by unusual intensity of those two hydrogen lines. The line $H\xi$ is more intense than $H\nu$, as has been stated above, but $H\zeta$ shows no unusual intensity. The lines 3819.2, 4026.4, and 4471.8, belonging to the first subordinate series of helium, are the most intense lines due to this gas.

The most characteristic dark lines in this spectrum are at wave lengths 4089.2, 4116.2, and 4649.2. These lines reach a maximum in spectra of this class, and are considerably fainter in spectra of Class B 1 A. 4649.2 is more intense than the helium line 4471.8; 4089.2 is as intense as the helium line 4026.4; and 4116.2 is 2.0 as intense as line 4120.5, or 4144.0. The line 4096.9 is fainter than in spectra of Class Oe 5 B. The triplet, 4069.4, 4072.0, and 4075.9, recently identified with oxygen, forms a conspicuous group near $H\delta$. The calcium line, K, is better defined than other faint lines. The calcium line, H, appears also to be present, although not distinctly separated from the adjacent hydrogen line, $H\epsilon$. Spectra of faint stars which are photographed with one prism and do not show the less intense lines clearly, are recognized as belonging to this class by the presence of the well marked lines 4089.2, 4116.2, and 4649.2.

CLASS B 1 A.

Typical star, β Centauri, A. G. C. 19043.

All lines are dark. The number of faint lines is greater than in spectra of Class B, but none of the Orion lines have as great intensity with respect to the hydrogen lines as in that class. By the diminished intensity of lines 4089.2 and 4116.2, the region of Hδ has a slightly different aspect from the same region in spectra of Class B.

The hydrogen system includes Ho, as in Class B, and Hπ is faintly seen on a plate of long exposure. The additional lines of hydrogen are not seen in this or any following class of spectrum.

The lines of helium are more intense than in spectra of Class B. 4471.8 now exceeds 4649.2, and 4120.5 exceeds 4116.2, in intensity. 4120.5 and 4144.0 are equally intense. The helium line D_3, wave length 5875.9, is present, with an intensity 0.5 as great as Hβ, and is photographed on the isochromatic plate X 9199, exposure 62^m. This line is slightly bright on the edge of greater wave length. 4089.2, 4116.2, and 4649.2 are much less intense than in spectra of Class B. The calcium line, K, is faint. The calcium line, H, is not seen, and is perhaps concealed by the hydrogen line, Hε.

CLASS B 2 A.

Typical stars, γ Orionis, H. P. 979, and α Lupi, A. G. C. 19873.

These spectra differ from that of β Centauri of Class B 1 A principally in the greater intensity of the lines due to helium, in the diminished intensity of lines 4089.2 and 4649.2, and in the absence of line 4116.2.

The hydrogen lines are seen from Hξ to Hβ inclusive, and are about 0.4 as intense as in α Canis Majoris.

The lines due to helium and parhelium appear to reach their maximum intensity in spectra of this class. Those having the greatest intensities are at wave lengths 3819.2, 4009.5, 4026.4, 4144.0, 4387.8, 4471.8, and 4922.1, all of which belong to the first subordinate series of either helium or parhelium. The line 3964.6, of the principal series of parhelium, is well marked, as are also the lines of the second subordinate series of helium.

The characteristic lines of spectra of Classes B and B 1 A which are not due to helium are faint. 4089.2 and 4649.2 are about 0.5 as intense as in Class B 1 A, and 4116.2 is not seen. Among the fainter lines, 4267.4 and 4481.4 are noticeable. The line, K, is 2.0 as intense as in Class B 1 A.

CLASS B 3 A.

Typical star, α Pavonis, A. G. C. 27918.

A marked diminution in the number of Orion lines is noticed. Almost all of the fainter lines of the spectra of Class B 2 A have disappeared, and on plates taken with one prism, few dark lines are seen, except those due to hydrogen, or helium. The hydrogen lines are seen, from $H\xi$ to $H\beta$ inclusive, and are about 0.5 as intense as in α Canis Majoris.

The helium lines, while of about the same intensity as in spectra of Class B 2 A, are more prominent in this spectrum, on account of the faintness, or absence of many other lines. 4649.2 is extremely faint, and is not seen on plates taken with one prism. 4089.2 is not present. 4128.5, 4131.4, and 4481.4 are more intense than in spectra of Class B 2 A. 3926.8 is more intense than the line K.

CLASS B 5 A.

Typical star, φ Velorum, A. G. C. 13593.

The spectrum shows a decided advance towards spectra of Class A, in the increased intensity of the four lines, K, 4128.5, 4131.4, and 4481.4.

The lines of hydrogen are 0.6 as intense as in α Canis Majoris, and are seen from $H\pi$ to $H\beta$, inclusive.

The lines of helium are the same as in spectra of Class B 3 A, but they are less intense.

Almost all the fainter lines characteristic of the spectra of Classes B, B 1 A, and B 2 A, are absent. It is interesting to note that, of the three intense lines 4089.2, 4116.2, and 4649.2, characteristic of Class B, 4116.2 disappears in Class B 2 A, 4089.2 in Class B 3 A, and 4649.2 in Class B 5 A. They all become very faint in the class preceding the one in which they are invisible.

The line K is more intense than the helium line 3926.8. 4481.4 is 0.7 as intense as the helium line 4471.8.

The double line, 4128.5 and 4131.4, is intermediate in intensity between that of the two helium lines 4120.5 and 4144.0. In stars of this class in which the lines are broad, the line K is fainter than in the typical star.

CLASS B 8 A.

Typical star, γ Gruis, A. G. C. 29935.

Several of the solar lines visible in stars of Class A are first seen in spectra of Class B 8 A. The lines of hydrogen are 0.8 as intense as in α Canis Majoris, and are seen from Hκ to Hβ, inclusive. The hydrogen lines show haziness as in stars of Class A. Twelve Orion lines are certainly seen, eight of which are due to helium. All of these are faint, except 4026.4 and 4471.8. 4922.1, which is barely seen in the typical star, is more intense in several stars of this class. The combined intensity of the helium lines is much less than in Class B 5 A.

The line K is less intense than 4026.4. The adjacent lines, 4128.5 and 4131.4, when taken together, are more intense than 4144.0; when seen separately, each line is about as intense as 4144.0.

4481.4 in the typical star, is slightly more intense than 4471.8. In general, in stars of this class, these two lines are approximately equal, although in a few cases the helium line 4471.8 is a little more intense than the line 4481.4. The solar line 4233.6 is present, and 4173.6, 4179.5, 4383.7, and 4385.2 are faintly seen. The presence of these characteristic solar lines is interesting in establishing the connection between this class of spectra and those of the Sirian type, from whence the sequence can be traced as far as, and including, Class Mb.

CLASS B 9 A.

Typical star, λ Centauri, A. G. C. 15848.

The spectrum resembles that of α Canis Majoris, Class A, except that the helium lines 4026.4 and 4471.8 are present on plates of all dispersions. The hydrogen lines are 0.9 as intense as in α Canis Majoris.

The helium lines 4026.4 and 4471.8 are fairly well marked. The line 4026.4 is about 0.5 as intense as the line K; 4471.8 is about 0.5 as intense as 4481.4. It may be noted that of the two helium lines 4026.4 and 4471.8, which thus remain visible in the last Class of Orion stars, 4471.8 is also the first to be seen in this series, being present and bright in Class Oc. A bright band also appears to coincide with the helium line 4471.8 in Class Oa. The presence of 4026.4 is undetermined in the spectra of the bright line stars, owing to its proximity to the additional hydrogen line 4026.0.

CLASS A.

Typical star, α Canis Majoris, A. G. C. 8348.

This class of spectrum is characterized by the great intensity of the hydrogen lines. They are seen from Ho to Hβ inclusive, and attain their maximum intensity in this and the following Class, A 2 F. Their intensity, as compared with the solar lines, attains a maximum in Class A. No lines due to helium are seen in the typical star.

The line K is about 0.1 as intense as Hδ, but varies in different stars from 0.1 to 0.2 of the intensity of Hδ. On plates taken with three prisms, the calcium line H is separated from the hydrogen line Hε, and is nearly as intense as the line K. Excepting the hydrogen lines and the line K, 4481.4 is the most intense line present. On plate X 7946 taken with three prisms, 88 solar lines are measured between Hθ and Hβ, and 5 of greater wave length than Hβ, making a total of 93 solar lines. The solar lines 4128.5, 4131.4, 4173.6, 4179.5, 4233.6, 4383.7, and 4385.2 are the most conspicuous, but no one of them is more than 0.2 as intense as the line K.

CLASS A 2 F.

Typical star, ι Centauri, A. G. C. 18149.

The spectrum is like that of α Canis Majoris, except that the line K is more intense, and the solar lines are more numerous and more intense. The lines of hydrogen are as intense as in α Canis Majoris.

In the typical star, the line K is about 0.4 as intense as Hδ, but in different stars of the class it varies from 0.3 to 0.5 of the intensity of Hδ. The calcium line H is not seen apart from Hε in any star of this class except α Cygni. The lines in that star are very narrow, and on plates taken with two prisms, H and Hε are well separated. The hydrogen line, Hε, however, in all the stars of this class, is 0.3 or 0.4 more intense than lines Hδ, Hγ, or Hβ. This is doubtless due to the presence of the calcium component. No helium lines are seen in this or any following class of stars. The solar lines are distinctly seen even on plates taken with one prism. 4481.4 is still the most conspicuous solar line, and is often sharply defined when all the other solar lines are indistinct. 4227.0, which is about 2.0 as intense as in Class A, and 4233.6 make a nearly equal pair.

CLASS A 3 F.

Typical star, τ^3 Eridani, A. G. C. 3284.

The spectrum resembles that of Class A 2 F, except that the line K is more intense, and the solar lines are more numerous and more intense.

The lines of hydrogen are nearly if not quite as intense as in α Canis Majoris.

The line K is more than 0.5 as intense as the compound line H and Hε, but in no star of this class does the line K equal this compound line. The line K is also 0.8 or 0.9 as intense as Hδ, but never exceeds Hδ in intensity.

The calcium line H is not separated from the hydrogen line Hε, but this compound line is fully 1.5 as intense as Hδ, Hγ, or Hβ.

The solar lines are more prominent than in Class A 2 F. 4227.0 and 4233.6 are often as intense as 4481.4.

The divisions between successive classes of spectra are perhaps more difficult to define in the classes ranging from A to F than in any others. The steady increase in intensity of the line K and the solar lines, together with an equally steady decrease in the intensity of the hydrogen lines, constitute all the changes observed except in a few peculiar stars. It is thus manifest that all subdivisions must be necessarily arbitrary, and that in each class, spectra will be found which vary slightly from that of the typical star.

CLASS A 5 F.

Typical star, α Pictoris, A. G. C. 8570.

The lines of hydrogen, seen from Hι to Hβ inclusive, are fainter than in α Canis Majoris, and are estimated as about 0.7 as intense as in stars of Class A.

The line K is 0.9 as intense as the compound line H and Hε, and has been estimated in various stars of this class to be from 1.1 to 1.5 as intense as Hδ.

The solar lines resemble those of α Carinæ, Class F, although the fainter lines of α Carinæ are not seen in this spectrum.

4481.4 is no longer conspicuous among the solar lines, many others being equally intense. The lines 4299.2, 4300.8, and 4302.6 are more intense than in Class A 3 F, but the lines 4305.8, 4308.0, and 4309.5, of the band G are not distinctly seen. 4326.0 is very faint. All the lines in this spectrum are somewhat hazy, and no star in this class has very sharp lines.

CLASS F.

Typical star, α Carinæ, A. G. C. 7843.

This spectrum is intermediate between Secchi's first and second types.

The lines of hydrogen are 0.5 as intense as in α Canis Majoris. The ultra violet portion of the spectrum is photographed with unusual clearness. Nineteen hydrogen lines are seen from Hυ to Hβ inclusive. Hυ is very faint, and the lines Hτ and Hξ appear double. The line K is equal in intensity to the compound line H and Hε, and nearly 3.0 as intense as Hδ.

There is no appearance of continuity in the band G. 4305.8, 4308.0, 4309.5, and 4313.0 are distinctly seen on plates taken with three prisms, but they are so faint that they do not form a continuous band between the well marked lines 4302.6 and 4315.2, as they do in the solar spectrum.

On X 8114, an isochromatic plate, taken with three prisms, 326 solar lines have been measured, 74 of which have greater wave length than Hβ.

Many of these lines are faint, and none of them has an intensity of more than 0.3 or 0.4 that of Hδ. Several bright bands of short wave length are seen, the most marked being nearly midway between Hζ and K and about as wide as Hζ. Fainter bands appear between Hη and Hζ, and between K and Hϵ.

The solar line 3727.5, between Hμ and Hλ, is well marked. Another well marked line at about 3714 is seen.

Class F 2 G.

Typical star, π Sagittarii, A. G. C. 26225.

This spectrum resembles that of α Carinæ, except that the lines 4308.0 and 4309.5 are more intense and are seen even on spectra photographed with one prism, when together they appear 0.7 as intense as 4315.2. The increased intensity of the two lines, 4308.0 and 4309.5, gives a slight appearance of continuity to the band G, although less marked than in spectra of Class F 5 G, while the hydrogen lines are as intense as in α Carinæ of Class F.

Class F 5 G.

Typical stars, α Canis Minoris, H. P. 1442, and ρ Puppis, A. G. C. 10763.

These spectra have many points of resemblance to that of the Sun, but the hydrogen lines are 2.0 or 3.0 as intense as in the solar spectrum, and the solar lines are fainter and less numerous.

The hydrogen lines are about 0.4 as intense as in the spectrum of α Canis Majoris. The line Hϵ is united with the wide band H of calcium. The line K is 1.1 as intense as the compound line H and Hϵ.

4326.0, although distinctly visible even on plates taken with one prism, is not more than 0.1 as intense as Hγ. 4227.0 is 0.8 as intense as in the spectrum of α Aurigae of Class G, and 3.0 as intense as in the spectrum of α Carinæ of Class F. On plates taken with one prism, the band G appears to be nearly continuous from 4299.2 to 4315.2. On plates taken with three prisms, the band G consists of four well marked lines, 4299.2 to 4300.8, 4302.6, 4308.0 to 4309.5, and 4315.2, with 4305.8 and 4313.0 very indistinctly seen. The double line 4308.0 and 4309.5, which increases steadily in intensity from the spectra of Class F to those of Class Ma, is more intense in the spectrum of α Canis Minoris than 4315.2, and nearly as intense as the double line 4299.2, and 4300.8.

CLASS F 8 G.

Typical star, α Fornacis, A. G. C. 3462.

The spectrum resembles that of α Aurigæ as far as a comparison can be made with plates taken with two prisms, except that the lines of hydrogen are nearly 2.0 as intense as in the spectrum of α Aurigæ.

CLASS G.

Typical star, α Aurigæ, H. P. 932.

The spectrum closely resembles that of the Sun. The hydrogen lines are 0.2 as intense as in the spectrum of α Canis Majoris. The line Hγ is 1.5 as intense as 4326.0. When separated from the adjacent line, 4337.6, Hγ is fully 3.0 as intense as that line. The lines 4076.8 to 4077.9, Hδ, and 4227.0, are about equally intense. The lines H and K of calcium, and the band G, are the most conspicuous features of the spectrum. The line K in this spectrum is 2.0 as intense as Hδ in the spectrum of α Canis Majoris. The band G is continuous on plates taken with one or two prisms, but with greater dispersion, spaces are seen between 4302.6 and 4305.8, and between 4305.8 and 4308.0.

An isochromatic plate, X 8109, shows the region of greater wave length, as far as the D lines. The wave lengths and intensities of the lines from Hβ to the D lines agree closely with those in the solar spectrum, and thus confirm the general resemblance of this spectrum to that of the Sun.

CLASS G 5 K.

Typical star, α Reticuli, A. G. C. 4812.

This spectrum differs from that of α Aurigæ in the diminished intensity of the hydrogen lines, and in the absorption of light towards the end of shorter wave length. The line Hγ when combined with line 4337.6 is equal in intensity to 4326.0; when separated from 4337.6, Hγ is about 0.9 as intense as 4326.0.

The region of shorter wave length than Hδ is fainter than in α Aurigæ, and the region of shorter wave length than the line K is barely seen on plates having a normal exposure. On plates taken with one prism, some spaces between dark lines are brighter than others, and at least two wide bands brighter than the adjacent portions of the spectrum are noticed extending from about wave lengths 4470 to 4525, and from 4614 to 4648. The space between lines 4077.9 and Hδ also appears like a bright band.

Class K.

Typical stars, α Phœnicis, A. G. C. 355, and ε Scorpii, A. G. C. 22731.

These spectra are intermediate between Secchi's second and third types.

The lines of hydrogen are not more than 0.08 as intense as in the spectrum of α Canis Majoris. The line Hγ is less than 0.5 as intense as 4326.0. The line K attains its maximum intensity in the spectra of this and the two following classes. It is 1.2, or 1.3, as intense as the compound line H and Hε. It is also 3.0, or 4.0, as intense as Hδ in the spectrum of α Canis Majoris. 4227.0 is 0.3 as intense as Hδ in the spectrum of α Canis Majoris, but not more than 0.5 as intense as the same line in the spectrum of α Tauri of Class K 5 M. The band G is continuous as in the spectrum of α Aurigæ. The two bright bands 4470 to 4525, and 4614 to 4648 are more intense than in spectra of Class G 5 K, and are bright enough to be seen on plates taken with two or three prisms. The portion of the spectrum from the line K to band G is fainter than the portion of greater wave length except the spaces between 4077.9 and Hδ, and between 4215.7 and 4227.0, which appear like bright bands.

The numerous stars of this class show no peculiarities or variations from the typical stars, except in the amount of absorption of light in the region extending from the line K to the band G, and in the relative brightness of the bands 4470 to 4525, and 4614 to 4648. These effects were found to vary so much in different photographs of the same star taken under different conditions, that they have been assumed to be photographic effects, rather than real.

Class K 2 M.

Typical star, υ Libræ, A. G. C. 21146.

This spectrum resembles that of α Tauri, Class K 5 M, in the intensities of the solar lines, and in the faintness of the image towards the end of shorter wave length. The band G, however, is still continuous, as in the spectra of Class K, and no traces of the sudden breaks in light at wave lengths 4762 and 4954 are seen. 4227.0 is 0.7 as intense as in the spectrum of α Tauri.

Class K 5 M.

Typical star, α Tauri, H. P. 797.

The spectrum shows a decided resemblance to stars of the well marked third type. The lines of hydrogen are about 0.05 as intense as in α Canis Majoris, and are inconspicuous among the numerous solar lines. Owing to the red color of this star, the spectrum in the region of shorter wave length than the line K is too faint to appear on the photographs. The bands K and H, and the line 4227.0, are the most conspicuous characteristics of the spectrum. The bands K and H are of the same width and intensity as in α Phœnicis, and 4227.0 is fully 0.6 as intense as Hδ in α Canis Majoris.

The band G is not continuous. On plates taken with one prism, a wide central line is seen, which comprises lines 4305.8, 4308.0, and 4309.5. The lines 4314.3 and 4315.2, seen as one, are almost entirely disconnected on the side of greater wave length. The lines 4299.2 and 4300.8, also seen together, are disconnected on the side of shorter wave length. On plates taken with three prisms, the band G is resolved into lines, and no part of it is as conspicuous as 4227.0. The lines 4383.7 to 4385.2, and 4405.0 to 4408.5 form a conspicuous pair on plates of all dispersions. 4405.0, when separated from 4408.5, is about 0.7 as intense as lines 4383.7 to 4385.2. The absorption bands, whose edges are at wave lengths 4762, 4954, and 5168, are present and, although faint, are clearly seen on plates taken with one prism. There is also a sudden diminution in intensity at Hβ, which is nearly as conspicuous as the similar changes at 4762 and 4954. Between the bright bands 4470 to 4525, and 4614 to 4648, a third but fainter bright band having the wave length 4556 to 4586 is present.

Class Ma.

Typical star, γ Hydri, A. G. C. 4353.

The spectrum is banded, and belongs to Secchi's third type. The two bands, faintly seen in the spectra of Class K 5 M, extending from 4762 to 4954, and from 4954 to 5168, are now well marked. The edges 4762, 4954, and 5168, are brighter than the adjacent continuous spectrum, and the change in intensity from these edges towards the end of greater wave length is abrupt. The diminution in light at Hβ is now much less conspicuous than the similar changes at 4762 and 4954. The bright band 4556 to 4586 is more conspicuous than in the spectrum of α Tauri, and nearly as intense as band 4470 to 4525. The space between 4657.0 and 4668.0 is bright. The lines of hydrogen are of about the same intensity as in the spectrum of α Tauri. 4227.0 is 1.2 as intense as in the spectrum of α Tauri. The part of the spectrum of shorter wave length than 4307 is faint, except between the line 4077.9 and Hδ, and the bands K and H are barely seen on plates having a normal exposure. The lines that formed the band G in classes G to K are now well separated. 4315.2 is very faint.

CLASS Mb.

Typical star, γ Crucis, A. G. C. 17048.

The edges of four absorption bands at wave lengths 4762, 4954, 5168, and 5445, are distinctly bright, and the abrupt change in light from these edges towards the end of greater wave length of the spectrum is more marked than in Class Ma. The bands fade gradually in light from these edges towards the end of shorter wave length. Numerous bands brighter than adjacent portions of the spectrum are present. Two of these bands are very conspicuous. One extends from 4556 to 4586, as in Class Ma, but is more intense than in that class. The other extends from 4614 to 4626, being narrower, with more sharply defined edges than in classes K 5 M and Ma. These two bands are of equal intensity in Class Mb. Band 4470 to 4525 is fainter than in Class Ma, and generally does not have the appearance of a distinct band. The space between lines 4657.0 and 4668.0 forms a narrow bright band which is as intense as band 4614 to 4626.

The lines of hydrogen are even fainter than in Class Ma, and are not more than 0.03 or 0.04 as intense as in the spectrum of α Canis Majoris. Line 4227.0 reaches its greatest intensity in spectra of this class, and is as intense as Hδ in the spectrum of α Canis Majoris. 4299.2 and 4300.8, and the compound lines 4305.8, 4308.0, and 4309.5, are the only conspicuous lines remaining of the band G. On the isochromatic plate, X 9180, three absorption bands are seen at the extreme end of greater wave length. The edges of these bands are at 5763, 5816, and 5857, approximately. These edges are less intense than those at 4762, 4954, 5168, and 5445.

CHAPTER XII.

CLASSIFICATION OF SPECTRA.

TABLE XVI gives the classification of 1122 stars by means of their photographic spectra, arranged in the order of classes as described in Chapter X. The first column contains the letter, or letters, designating the class of spectrum, according to the notation explained in the outline of this classification. The first star following the designation of the class, is considered a typical star, or the first two stars in cases where two typical stars have been used. A detailed description of each typical spectrum is to be found in Chapter XI. The letters Pec., placed after the designation of a class, indicate that the spectrum differs essentially from that of the typical star. The peculiarities are then described in the remarks following the table. The letters Comp. are added after the name of the class of spectrum to signify that the spectrum is composite. When the name of the class is printed in Italics, as in classes *B 1 A*, *B 2 A*, *B 3 A*, *B 5 A*, and *B 8 A*, it indicates the presence of one or more bright hydrogen lines.

In the general arrangement of the stars of each class, the aim has been to place first the best examples of spectra similar to that of the typical star. Fainter stars, whose spectra cannot be compared so minutely with the typical spectrum, but which show the same general characteristics, are placed towards the end of each class. For convenience of reference, groups of stars showing similar peculiarities are arranged together. Stars marked Pec., Comp., and those of the Orion type having bright hydrogen lines, are placed at the end of each class in which they occur.

The second column gives the number of each star in the Argentine General Catalogue, if the star is contained in that catalogue. Otherwise, except in five cases, the number of the star in the Harvard Photometry is used, and the letters H. P. are then placed before the number. Five stars, whose spectra were photographed, are not contained in either of the catalogues named above. Three of these stars are in the Durchmusterung, and are indicated by the zone and number in that catalogue. The other two are in the Cordoba Zone Catalogue, and are indicated by the hour and number of the star in that catalogue. The numbers in the second column are italicized when the star is double and the fainter spectrum is not classified, or, when two spectra are superposed, only one being classified, while the lines of the other are referred to in the remarks.

The third and fourth columns give the constellation and designation.

The fifth column gives a number, which refers to the remarks on individual spectra, following the table. In the remarks, the name or catalogue number of each star is repeated after the number of the remark, except in cases where the remark is general and applies to more than one star.

The sixth column gives the greatest number of prisms with which each spectrum has been photographed.

TABLE XVI.

CLASSIFICATION OF SPECTRA.

Class.	Cat. No.	Constellation.	Des.	Remarks.	Prs.	Class.	Cat. No.	Constellation.	Des.	Remarks.	Prs.
P	14204	Hydra	—	1	1	B	6501	Orion	ϵ	—	3
Q	14720	Carina	η	2	1	"	10268	Puppis	P	—	1
"	14965	Carina	—	3	1	"	12035	Vela	f	—	2
"	14971	Carina	—	4	1	"	6614	Orion	ζ	18, 19	3
Oa	15305	Carina	—	—	1	"	6401	Orion	δ	18, 19	3
"	22827	Scorpius	—	—	2	"	24850	Sagittarius	—	—	1
"	−21° 4864	Sagittarius	—	—	1	"	22626	Ara	—	20	2
"	10^h 2684	Carina	—	—	1	"	21685	Scorpius	δ	18, 21	2
"	8^h 4141	Vela	—	—	1	"	22451	Scorpius	τ	22	2
" Pec.	10863	Vela	γ	5	2	"	14667	Carina	θ	23	2
" Pec.	*17840*	Musca	θ	6	1	"	14489	Carina	—	24	1
Ob	8631	Canis Major	—	7	1	"	*14483*	Carina	—	24, 230	1
Oc	22763	Scorpius	—	—	2	"	6481	Orion	—	25	1
"	14691	Carina	—	8	1	"	6482	Orion	—	25	1
" Pec.	14684	Carina	—	9	1	"	15175	Carina	—	—	1
" Pec.	14626	Carina	—	10	1	"	22814	Scorpius	—	26, 27	2
Od	10691	Puppis	ζ	11	2	"	*22824*	Scorpius	—	28	1
Oe	9311	Canis Major	—	—	1	"	22845	Scorpius	—	29	1
"	22748	Scorpius	—	12	2	"	14698	Carina	—	27	1
"	22843	Scorpius	—	13	2	B 1 A	19043	Centaurus	β	—	3
Oe 5 B	9313	Canis Major	τ	—	1	"	22158	Scorpius	σ	30	2
"	20649	Circinus	δ	—	1	"	17411	Crux	β	30, 31	2
"	20695	Circinus	—	—	1	"	7989	Canis Major	ξ^1	—	1
"	17572	Crux	—	14	1	"	18559	Centaurus	ϵ	—	2
"	6486	Orion	ι	15	1	"	*16942*	Crux	α^1	18, 32	2
"	6478	Orion	θ^1	16	1	"	23515	Ara	γ	18, 33	2
"	14811	Carina	—	17	1	"	10392	Puppis	J	18, 34	1

Class.	Cat. No.	Constellation.	Des.	Remarks.	Prs.
B 1 A	7467	Pictor	δ	18	1
"	*21805*	Scorpius	β	35	1
"	24854	Sagittarius	—	—	1
"	14903	Carina	—	—	1
"	8602	Canis Major	—	—	1
"	16704	Crux	—	29	1
"	6542	Orion	—	—	1
"	6533	Orion	—	36	1
"	6484	Orion	θ^2	37	1
"	—5° 1320	Orion	—	37	1
"	6469	Orion	—	38	1
"	6471	Orion	—	38	1
"	20640	Circinus	—	—	1
"	24574	Ara	θ	39, 40	2
"	8752	Canis Major	ε	39, 40	2
" Pec.	10534	Puppis	V	41	2
" Pec.	23098	Scorpius	k	42	1
" Pec.	22297	Norma	—	42	1
B 1 A Pec.	22812	Scorpius	ζ^1	40, 43	2
B 2 A	H.P. 979	Orion	γ	—	3
"	19873	Lupus	α	—	2
"	11806	Pyxis	α	—	2
"	22778	Scorpius	μ^2	—	3
"	18772	Centaurus	ν	—	2
"	11790	Carina	d	—	1
"	23966	Scorpius	κ	18	2
"	23778	Scorpius	λ	18	3
"	18262	Virgo	α	18	1
"	25692	Pavo	λ	18	1
"	20779	Lupus	δ	18	2
"	11248	Vela	B	18	1
"	21841	Scorpius	ω^1	—	1
"	19661	Lupus	σ	—	1
"	10269	Puppis	—	—	1
"	10211	Puppis	—	—	1
"	7697	Columba	—	—	1
" Pec.	20263	Lupus	β	44	2
" Pec.	18897	Centaurus	ζ	45	2
" Pec.	21638	Scorpius	π	46	2
B 2 A	18773	Centaurus	μ	47	2
"	8518	Canis Major	κ	18, 48	2
"	10182	Puppis	ο	18, 49	2
B 3 A	27918	Pavo	α	—	3
"	7681	Canis Major	ζ	—	2
"	17156	Musca	α	—	2
"	12535	Carina	a	—	2
"	12788	Vela	κ	—	2
"	20286	Centaurus	κ	50	2
"	10390	Puppis	—	50	2
"	18960	Centaurus	φ	—	2
B 3 A	25105	Telescopium	α	—	2
"	10507	Carina	χ	—	2
"	23698	Scorpius	υ	—	3
"	20806	Lupus	ε	—	2
"	23500	Ophiuchus	θ	—	2
"	19107	Centaurus	χ	—	1
"	21095	Lupus	d	—	1
"	17826	Centaurus	ξ^2	—	1
"	18968	Centaurus	υ^1	—	1
"	27344	Sagittarius	θ^1	—	1
"	16778	Crux	ζ	—	1
"	10350	Puppis	b	—	1
"	9338	Puppis	v^2	—	2
"	7064	Columba	γ	—	1
"	22347	Scorpius	N	—	1
"	20514	Lupus	λ	—	1
"	10188	Puppis	—	—	1
"	H.P. 845	Orion	π^4	—	1
"	16652	Centaurus	ρ	—	1
"	5106	Cælum	δ	—	1
"	14829	Chamæleon	δ^2	—	1
"	21084	Lupus	γ	18	2
"	25874	Sagittarius	σ	18	3
"	*21653*	Lupus	η	18, 51	2
"	17374	Musca	β	18	2
"	19354	Lupus	ι	18	2
"	20825	Lupus	ϕ^2	18	2
"	16726	Crux	δ	18	2
"	21186	Libra	τ	—	2
"	*11760*	Vela	ο	52	2
"	17541	Crux	μ	53	1
"	21469	Scorpius	b	—	2
"	21521	Scorpius	A	—	2
"	16976	Centaurus	σ	—	1
"	21810	Lupus	θ	—	1
"	20591	Lupus	e	—	1
"	19514	Lupus	τ^1	54	1
"	10678	Carina	D	—	1
"	12557	Carina	i	—	1
"	11956	Carina	f	—	1
"	19890	Centaurus	b	—	1
"	21592	Scorpius	ρ	55	1
"	16479	Crux	θ^2	—	1
"	*12221*	Carina	b^1	56	2
"	16946	Centaurus	G	57, 58	1
"	9060	Puppis	A	58	1
"	17540	Crux	λ	59	2
"	17811	Centaurus	f	60	1
"	11622	Carina	e^1	61	1
"	17390	Crux	—	—	1

Class.	Cat. No.	Constellation.	Des.	Remarks.	Prs.
B 3 A	9881	Puppis	—	62	1
"	25565	Sagittarius	—	—	1
"	10331	Puppis	—	—	1
"	11797	Vela	—	—	2
"	13964	Carina	—	—	1
"	22613	Ara	—	—	2
"	15152	Carina	—	—	1
"	15204	Carina	—	—	1
"	20463	Lupus	—	—	1
"	10558	Puppis	—	—	1
"	10055	Puppis	—	—	2
"	9276	Puppis	—	—	2
"	12149	Carina	—	—	2
"	12370	Vela	—	—	1
"	12593	Vela	z	—	1
"	10779	Carina	—	—	1
"	9165	Canis Major	—	—	1
"	8671	Canis Major	—	—	1
"	9123	Canis Major	—	—	1
"	9121	Canis Major	—	—	1
"	9168	Canis Major	—	—	1
"	9374	Canis Major	—	—	1
"	13077	Vela	—	—	1
"	10861	Vela	—	63	2
"	14902	Carina	—	—	1
"	15377	Carina	—	—	1
"	10873	Vela	—	—	2
"	14653	Carina	—	—	1
"	14692	Carina	—	—	1
"	14702	Carina	—	—	1
"	14583	Carina	—	—	1
"	7914	Canis Major	—	—	1
"	24156	Sagittarius	—	—	1
"	10109	Puppis	—	—	1
"	8815	Canis Major	—	—	1
"	12298	Vela	—	—	1
"	11194	Puppis	—	—	1
"	15862	Centaurus	—	—	1
"	14571	Vela	—	29, 58	1
"	*8017*	Canis Major	—	—	1
"	10646	Puppis	—	—	1
"	14536	Carina	—	—	1
"	10693	Puppis	—	—	1
"	20450	Lupus	—	—	1
"	10920	Vela	—	—	1
"	10856	Vela	—	—	1
"	10781	Vela	—	—	1
"	18135	Musca	—	—	1
"	18819	Centaurus	—	—	1
"	9334	Canis Major	—	64	1
B 3 A	10568	Puppis	—	65	1
"	10566	Puppis	—	65	1
"	*10973*	Puppis	—	66	1
"	*10986*	Vela	—	220	1
"	*24839*	Sagittarius	—	67	1
"	9031	Canis Major	—	68	1
"	9621	Puppis	—	68	1
"	9940	Puppis	—	68	1
"	10145	Puppis	—	68	1
"	10613	Carina	—	—	1
"	10953	Vela	—	—	1
"	10989	Vela	—	—	1
"	14623	Carina	—	68	1
"	8742	Canis Major	—	68	1
"	10430	Puppis	—	29	1
"	10387	Puppis	—	29	1
"	9902	Puppis	—	69	1
"	14663	Carina	—	58	1
"	18172	Centaurus	—	70	1
"	6616	Orion	—	—	1
"	8520	Canis Major	—	29	1
"	6483	Orion	c	68	1
"	6512	Orion	—	68	1
"	6535	Orion	—	68	1
"	6503	Orion	—	68	1
"	11024	Vela	—	71	1
" Pec.	14656	Carina	—	40, 72	1
" Pec.	22761	Scorpius	μ^1	73	3
B 3 A	16572	Centaurus	δ	18, 74	2
"	23694	Ara	α	18, 75	2
"	9198	Canis Major	ω	76	2
"	9326	Puppis	v^1	18, 77	2
"	10963	Puppis	r	78	1
"	12465	Carina	E	18, 79	2
"	17717	Musca	—	18, 80	2
"	19273	Centaurus	—	18, 81	1
"	17542	Crux	—	53	1
"	18859	Centaurus	—	81	1
"	8991	Canis Major	—	82	1
B 3 A Comp.	19737	Centaurus	η	83	2
B 5 A	13593	Vela	ϕ	—	2
"	25255	Telescopium	δ^2	—	2
"	13112	Carina	h	—	1
"	19358	Centaurus	v	—	1
"	6972	Dorado	ϵ	—	1
"	2556	Eridanus	κ	84	1
"	902	Sculptor	α	—	1
"	1594	Eridanus	α	18, 85	3
"	17072	Musca	γ	18	2
"	19785	Lupus	ρ	18	1

Class.	Cat. No.	Constellation.	Des.	Remarks.	Prs.	Class.	Cat. No.	Constellation.	Des.	Remarks.	Prs.
B 5 A	16766	Chamæleon	β	18	1	B 5 A	12809	Vela	—	—	1
“	16151	Centaurus	j	18	1	“	25886	Corona Aust.	—	—	1
“	15539	Centaurus	π	18	1	“	11917	Vela	—	91	1
“	*18855*	Centaurus	h	223	1	“	*16566*	Centaurus	—	92	2
“	*18833*	Centaurus	k	224	1	“	6182	Columba	—	93	1
“	20109	Lupus	o	—	1	“	12723	Vela	—	29	1
“	7904	Canis Major	λ	—	1	“	10053	Puppis	—	68	1
“	6937	Columba	λ	—	1	“	7321	Columba	—	57	1
“	20428	Lupus	π	—	1	“	16329	Crux	—	—	1
“	32389	Sculptor	ζ	—	1	“	6487	Orion	—	68	1
“	4101	Fornax	δ	—	1	“	19445	Centaurus	a	94	1
“	32130	Phœnix	σ	—	1	“ Pec.	29598	Capricornus	ϵ	95	1
“	21274	Lupus	ψ^2	—	1	“ Pec.	8873	Canis Major	σ^2	40, 96	2
“	4336	Eridanus	τ^8	—	1	“ Pec.	9476	Canis Major	η	40, 96	2
“	30241	Grus	α	18, 86	3	*B 5 A*	6633	Columba	α	18, 97	2
“	H.P. 618	Taurus	η	86	2	“	14392	Carina	p	18, 98	2
“	H.P. 615	Taurus	—	86	2	“ Pec.	14145	Vela	J	99	1
“	H.P. 610	Taurus	q	86	2	“ Pec.	20878	Apus	κ^1	100	1
“	H.P. 613	Taurus	—	86	2	“ Pec.	9181	Canis Major	—	101	2
“	H.P. 608	Taurus	—	86	2	B 5 A Comp.	20785	Circinus	γ	102	1
“	*22246*	Norma	ϵ	87	1	B 8 A	29935	Grus	γ	—	2
“	18174	Centaurus	J	70	1	“	25614	Sagittarius	ϕ	—	2
“	*10923*	Volans	ϵ	88, 89	1	“	25243	Telescopium	δ^1	—	2
“	9935	Puppis	d^3	—	1	“	*26485*	Sagittarius	β^1	103	2
“	12180	Vela	H	—	1	“	26527	Sagittarius	α	—	2
“	20909	Lupus	—	—	2	“	12175	Carina	c	—	2
“	22147	Norma	—	—	1	“	25153	Pavo	ν	—	1
“	14846	Carina	—	—	1	“	*20713*	Lupus	μ	226	1
“	9287	Canis Major	—	—	1	“	23636	Ara	δ	18	2
“	10510	Puppis	—	—	1	“	2339	Eridanus	ϕ	18	2
“	21728	Lupus	—	—	1	“	14008	Carina	ω	18	2
“	26198	Corona Aust.	—	—	1	“	H.P. 1797	Leo	α	18	1
“	14775	Carina	—	—	1	“	8181	Puppis	ν	18, 104	2
“	12638	Carina	—	—	2	“	H.P. 625	Taurus	—	105	2
“	14764	Carina	—	68	1	“	30889	Piscis Aust.	ϵ	—	1
“	11786	Vela	—	—	1	“	15950	Hydra	o	—	1
“	12297	Vela	—	—	1	“	19577	Hydra	l	—	1
“	10999	Puppis	—	—	1	“	9850	Puppis	f	—	1
“	11424	Vela	A	—	1	“	15183	Hydra	χ^2	106	1
“	14664	Carina	—	—	1	“	17234	Centaurus	l	107	1
“	11733	Vela	—	68	2	“	4242	Eridanus	f	108	1
“	11751	Vela	—	—	2	“	*1069*	Phœnix	ζ	218	1
“	18929	Centaurus	—	57	1	“	15825	Centaurus	A	—	1
“	11817	Vela	—	—	2	“	3897	Eridanus	τ^5	—	1
“	14788	Carina	—	—	1	“	9880	Puppis	k	62	1
“	16939	Crux	—	90	1	“	21078	Apus	κ^2	—	1
“	12759	Carina	—	89	1	“	20731	Lupus	—	—	2
“	14730	Chamæleon	—	89	1	“	9244	Puppis	—	—	1
“	12515	Vela	—	—	2	“	21360	Lupus	—	—	1
“	20670	Lupus	—	—	1	“	25020	Sagittarius	—	—	1

Class.	Cat. No.	Constellation.	Des.	Remarks.	Prs.	Class.	Cat. No.	Constellation.	Des.	Remarks.	Prs.
B 8 A	30057	Indus	—	—	1	B 9 A	7513	Dorado	ν	—	1
"	24169	Scorpius	—	—	1	"	451	Tucana	β^1	117	1
"	10088	Puppis	—	—	1	"	20570	Lupus	κ	118	2
"	17489	Centaurus	—	—	1	"	25897	Telescopium	λ	119	1
"	24630	Ara	—	106	1	"	14319	Antlia	δ	—	1
"	17936	Centaurus	—	—	1	"	13217	Carina	m	—	1
"	17989	Musca	η	—	1	"	26843	Sagittarius	h^2	120	1
"	23522	Scorpius	—	—	1	"	12330	Vela	—	—	1
"	16959	Crux	—	—	1	"	11814	Vela	—	—	2
"	17270	Crux	—	—	1	"	20048	Hydra	—	—	1
"	25895	Sagittarius	—	—	1	"	1871	Phœnix	φ	121	1
"	7164	Columba	—	—	1	"	19598	Lupus	—	122	1
"	7672	Columba	—	—	1	"	19930	Libra	—	122	1
"	23656	Ara	—	—	1	"	4286	Eridanus	—	122	1
"	14573	Vela	—	—	1	"	9589	Puppis	—	123	1
"	14417	Carina	—	—	1	"	23633	Ophiuchus	—	—	1
"	15318	Carina	—	—	1	A	8348	Canis Major	α	—	3
"	13453	Vela	—	109	1	"	H.P. 3147	Lyra	α	—	3
"	16080	Centaurus	—	57	1	"	17269	Centaurus	γ	124	2
"	25182	Sagittarius	—	—	1	"	12636	Carina	β	124	2
"	23472	Ara	—	—	1	"	11887	Vela	δ	124	2
"	9978	Puppis	—	—	1	"	11900	Vela	a	—	2
"	9900	Puppis	—	69	1	"	29200	Microscop.	ε	125	2
"	10565	Carina	—	68	1	"	25919	Sagittarius	ξ^1	125	2
"	14349	Vela	—	110	1	"	27225	Pavo	ε	125	2
"	14769	Carina	—	68	1	"	8133	Carina	N	126	1
"	8109	Canis Major	—	68	1	"	6141	Lepus	—	127	1
"	30762	Piscis Aust.	—	68	1	"	8065	Canis Major	ξ^2	—	1
"	28539	Capricornus	—	68	1	"	19387	Centaurus	ψ	128	1
"	19271	Apus	—	68	1	"	H.P. *1423*	Gemini	α	18, 129	3
"	10897	Carina	—	111	1	"	25060	Sagittarius	ε	18	3
"	13417	Vela	u	111	1	"	20657	Triang. Aust.	γ	18	2
"	4225	Eridanus	—	111	1	"	2838	Eridanus	s	18	2
"	26229	Sagittarius	—	111	1	"	31869	Aquarius	b^3	18	1
"	10639	Carina	—	111	1	"	19958	Centaurus	c^2	18	1
" Pec.	6004	Orion	β	40, 112	3	"	662	Phœnix	η	18	2
" Pec.	24812	Sagittarius	μ	40, 113	2	"	29737	Piscis Aust.	ι	18, 130	1
B 8 A	+23°558	Taurus	—	105	2	"	23739	Ophiuchus	c	—	1
B 9 A	15848	Centaurus	λ	—	2	"	20861	Lupus	k	—	1
"	28259	Pavo	υ	—	2	"	*30704*	Piscis Aust.	β	228	1
"	4821	Eridanus	X	114	2	"	31123	Piscis Aust.	γ	—	1
"	31859	Sculptor	β	—	1	"	32161	Sculptor	δ	—	1
"	21454	Lupus	χ	—	1	"	26027	Corona Aust.	ζ	—	1
"	11293	Volans	κ^1	115	1	"	4241	Eridanus	f	108	1
"	*2693*	Fornax	ω	116	1	"	1421	Cetus	—	—	1
"	2887	Hydrus	ε	—	1	"	21586	Lupus	ξ	131	1
"	16217	Hydra	β	—	1	"	21587	Lupus	—	131	1
"	16382	Chamæleon	ε	—	1	"	17747	Centaurus	ξ^1	124	1
"	32347	Tucana	ε	—	1	"	23805	Ara	σ	—	1
"	30594	Tucana	δ	—	1	"	15901	Centaurus	—	—	1

Class.	Cat. No.	Constellation.	Des.	Remarks.	Prs.	Class.	Cat. No.	Constellation.	Des.	Remarks.	Prs.
A	6404	Lepus	—	—	1	A 2 F	*3223*	Eridanus	θ	148	2
“	14827	Carina	—	—	1	“	4208	Eridanus	τ^7	—	2
“	26084	Sagittarius	—	—	1	“	28597	Microscop.	β	—	1
“	17149	Centaurus	—	—	1	“	3003	Hydrus	ζ	—	1
“	27237	Pavo	—	—	1	“	17180	Centaurus	τ	—	2
“	26000	Corona Aust.	—	—	1	“	30260	Piscis Aust.	μ	149	1
“	8624	Canis Major	—	—	1	“	2565	Fornax	φ	—	1
“	8500	Canis Major	—	—	1	“	31955	Phœnix	—	—	1
“	17939	Musca	—	—	1	“	443	Phœnix	λ^1	—	1
“	24765	Telescopium	—	—	1	“	15317	Crater	β	—	1
“	20571	Lupus	—	118	1	“	15048	Vela	i	—	1
“	2919	Fornax	—	132	1	“	32311	Tucana	η	—	1
“	9752	Puppis	—	133	1	“	29795	Piscis Aust.	θ	—	2
“	21827	Norma	ι^2	133	1	“	12013	Vela	g	57	1
“	9226	Canis Major	—	133	1	“	14283	Carina	—	—	1
“	8495	Canis Major	—	133	1	“	467	Tucana	—	—	1
“	17460	Centaurus	—	133	1	“	8646	Canis Major	—	—	1
“	17488	Centaurus	—	133	1	“	15253	Hydra	—	—	1
“	16978	Crux	—	133	1	“	16634	Corvus	—	—	1
“	*25197*	Sagittarius	—	133, 231	1	“	10482	Puppis	—	—	1
“	14624	Vela	—	133	1	“	10605	Puppis	—	—	1
“	14754	Carina	—	133	1	“	21694	Norma	ι^1	18	1
“	9243	Puppis	—	134	1	“	30268	Piscis Aust.	—	—	1
“	17504	Crux	—	135	1	“	20655	Lupus	—	—	1
“	*21206*	Lupus	—	136	1	“	8594	Canis Major	—	150	1
“	20847	Lupus	υ	137	1	“	27100	Pavo	—	—	1
“	14935	Vela	—	137	1	“	19597	Lupus	—	—	1
“	18646	Centaurus	—	137	1	“	30814	Grus	—	68	1
“	10618	Puppis	—	137	1	“	25500	Pavo	—	—	1
“	19057	Centaurus	—	137	1	“	25944	Sagittarius	—	—	1
“	11297	Volans	κ^2	138	1	“	8607	Canis Major	—	—	1
“	14606	Carina	—	138	1	“	18995	Centaurus	—	68	1
“	20787	Lupus	—	138	1	“	22949	Ara	—	68	1
“	19867	Centaurus	—	139	1	“	30604	Tucana	—	68	1
“	20035	Hydra	—	140	1	“	20801	Lupus	—	133	1
“	15269	Carina	—	140	1	“	9787	Puppis	—	133	1
“ Pec.	H.P. 5	Andromeda	α	141	3	“	6062	Columba	—	133	1
“ Pec.	H.P. 1100	Auriga	β	142	2	“	*32414*	Sculptor	—	133, 151	1
“ Pec.	2065	Fornax	ν	143	2	“	32324	Tucana	—	133	1
“ Pec.	4447	Eridanus	τ^9	144	1	“	23589	Ophiuchus	—	133	1
“ Pec.	5198	Dorado	α	145	2	“	30805	Grus	—	133	1
“ Pec.	9194	Puppis	L^1	146	2	“	31853	Phœnix	—	133	1
“ Pec.	29314	Microscop.	θ^2	147	1	“	20782	Lupus	—	133	1
A 2 F	18149	Centaurus	ι	—	2	“	15779	Centaurus	—	133	1
“	26041	Sagittarius	ζ	—	2	“	7274	Columba	—	133	1
“	2498	Hydrus	δ	—	2	“	19473	Hydra	—	133	1
“	13968	Vela	q	—	2	“	22165	Triang.Aust.	—	133	1
“	26189	Corona Aust.	α	—	2	“	12785	Vela	—	133	1
“	31044	Grus	ε	—	2	“	6458	Orion	—	133	1
“	14383	Carina	K	—	2	“	9131	Canis Major	—	133	1

Class.	Cat. No.	Constellation.	Des.	Remarks.	Prs.	Class.	Cat. No.	Constellation.	Des.	Remarks.	Prs.
A 2 F	17472	Crux	—	152	1	A 5 F	491	Tucana	θ	68	1
"	14404	Carina	—	153	1	"	17320	Centaurus	—	—	1
"	14528	Carina	—	153	1	"	5244	Cælum	—	—	1
"	16263	Centaurus	—	153	1	"	29117	Indus	—	—	1
"	16359	Centaurus	—	153	1	"	25233	Corona Aust.	—	—	1
"	14797	Carina	—	40	1	"	20716	Lupus	—	—	2
"	452	Tucana	β^2	40, 117	1	"	31083	Piscis Aust.	—	—	1
" Pec.	H.P. 3631	Cygnus	α	40, 154	2	"	30290	Piscis Aust.	—	132	1
" Pec.	10033	Puppis	l	40, 155	1	"	20376	Hydra	—	68	1
" Pec.	24182	Scorpius	ι^2	40, 156	1	"	20295	Hydra	—	68	1
" Pec.	15756	Centaurus	o^2	40,156,157	1	"	31934	Phœnix	—	133	1
" Pec.	29248	Microscop.	θ^1	158	1	"	31975	Phœnix	—	133	1
" Pec.	31906	Phœnix	ι	159	1	"	25160	Sagittarius	—	133	1
A 3 F	3284	Eridanus	τ^3	—	2	"	20959	Lupus	—	133	1
"	31213	Piscis Aust.	α	160	3	"	26977	Sagittarius	—	133	1
"	20668	Circinus	β	—	1	"	7034	Pictor	—	165	1
"	6848	Pictor	β	18	2	F	7843	Carina	α	—	3
"	351	Phœnix	κ	18	2	"	12672	Carina	ι	—	2
"	11770	Vela	n	—	2	"	*13389*	Carina	υ	221	2
"	27346	Sagittarius	θ^2	—	1	"	23849	Scorpius	θ	—	2
"	28879	Capricornus	η	—	1	"	1981	Hydrus	α	18	3
"	22146	Scorpius	o	—	1	"	21484	Triang. Aust.	β	—	2
"	419	Cetus	—	—	1	"	28140	Pavo	ϕ^1	—	1
"	10913	Puppis	—	—	1	"	9176	Puppis	I	—	1
"	26980	Pavo	—	—	1	"	19849	Circinus	α	166	2
"	9632	Puppis	—	—	1	"	22374	Ophiuchus	ω	167	1
"	18716	Centaurus	—	—	1	"	23614	Ophiuchus	b	168	1
"	25574	Pavo	θ	—	1	"	26500	Sagittarius	β^2	—	2
"	2024	Fornax	—	—	1	"	16541	Crux	η	—	1
"	25172	Sagittarius	—	—	1	"	28363	Indus	η	—	1
"	28595	Microscop.	—	161	1	"	29999	Indus	δ	—	1
"	19540	Lupus	—	161	1	"	30879	Octans	β	—	1
"	29717	Capricornus	—	162	1	"	4686	Horologium	δ	—	2
"	26827	Sagittarius	h^1	162	1	"	14304	Carina	s	—	1
" Pec.	21792	Norma	δ	163	1	"	12286	Carina	b^2	132	1
A 5 F	8570	Pictor	α	—	2	"	19379	Lupus	—	—	2
"	16085	Musca	λ	—	2	"	15004	Carina	—	—	1
"	H.P. 3429	Aquila	α	18	3	"	10689	Puppis	—	—	1
"	28338	Pavo	β	—	2	"	9250	Canis Major	—	169	1
"	24559	Pavo	π	—	1	"	6158	Columba	—	—	1
"	*29216*	Indus	θ	227	2	"	12235	Vela	—	—	1
"	16451	Crux	θ^1	—	1	"	14244	Carina	—	—	1
"	3279	Horologium	β	—	1	"	8592	Canis Major	—	150	1
"	12378	Volans	α	—	1	"	21828	Lupus	—	—	1
"	11111	Puppis	q	164	1	"	10546	Puppis	—	132	1
"	13145	Vela	M	164	1	"	9364	Canis Major	—	—	1
"	6852	Dorado	δ	—	1	"	*21767*	Lupus	—	170	1
"	17521	Centaurus	n	—	1	"	5810	Cælum	—	171	1
"	11653	Vela	e	—	1	"	6493	Orion	—	—	1
"	16845	Musca	ζ^2	—	1	"	13135	Vela	—	172	1

Class.	Cat. No.	Constellation.	Des.	Remarks.	Prs.
F	27438	Sagittarius	—	172	1
“ Pec.	633	Phœnix	ξ	173	2
F 2 G	26225	Sagittarius	π	—	2
“	23250	Scorpius	η	—	2
“	5295	Cælum	α	—	1
“	16576	Corvus	α	—	1
“	31563	Tucana	γ	—	2
“	14517	Vela	p	174	2
F 5 G	H.P. 1442	Canis Minor	α	—	3
“	10763	Puppis	ρ	—	2
“	4811	Dorado	γ	—	1
“	23629	Ophiuchus	d	—	2
“	21226	Lupus	g	—	1
“	14276	Carina	I	—	1
“	18696	Centaurus	i	—	1
“	5313	Cælum	β	—	1
“	12989	Vela	ψ	—	2
“	23481	Ophiuchus	ξ	—	1
“	*19997*	Hydra	m	175	1
“	24577	Sagittarius	W	—	2
“	15166	Hydra	χ^1	—	1
“	28179	Pavo	ρ	—	1
“	31380	Grus	θ	—	1
“	12620	Vela	k	—	1
“	3879	Reticulum	κ	—	1
“	11334	Chamæleon	α	—	1
“	12472	Carina	G	176	1
“	8658	Canis Major	π	—	1
“	25928	Corona Aust.	ε	—	2
“	427	Phœnix	—	—	1
“	27292	Sagittarius	—	—	1
“	29544	Capricornus	—	—	1
“	10904	Carina	B	—	1
“	22829	Scorpius	—	—	1
“	5798	Pictor	η^1	—	1
“	8724	Canis Major	—	—	1
“	769	Phœnix	ρ	—	1
“	18031	Musca	—	—	1
“	23888	Ara	λ	68	1
“	28516	Capricornus	—	—	1
“	20775	Circinus	—	—	1
“	28651	Capricornus	—	177	1
“	18232	Centaurus	—	—	1
“	H.P. 541	Perseus	α	178	3
“	6561	Dorado	β	179	2
“	25786	Pavo	κ	180	2
“	19027	Centaurus	υ^2	180	1
“	9407	Volans	δ	181	2
“ Pec.	24107	Scorpius	ι^1	40, 182	2
“ Pec.	11755	Vela	b	40, 182	2
F 5 G Pec.	15356	Carina	y	40, 182	1
“ Pec.	14295	Carina	—	40, 182	1
F 8 G	3462	Fornax	α	—	2
“	233	Tucana	ζ	—	2
“	6733	Lepus	γ	—	2
“	26123	Corona Aust.	γ	—	2
“	4191	Eridanus	τ^6	183	2
“	28455	Capricornus	ψ	183	1
“	30294	Piscis Aust.	τ	—	1
“	10450	Puppis	j	—	1
“	29309	Pavo	γ	—	1
“	23018	Ara	ϵ^2	—	1
“	519	Phœnix	λ^2	—	1
“	5893	Dorado	ζ	—	1
“	28236	Pavo	ϕ^2	—	1
“	10120	Puppis	—	—	1
“	19515	Lupus	τ^2	54	1
“	20786	Lupus	ν^1	—	1
“	*1210*	Tucana	κ	219	1
“	12253	Vela	w	—	1
“	17977	Centaurus	—	—	1
“	9733	Puppis	—	—	1
“	14083	Vela	—	—	1
“	25032	Telescopium	—	—	1
“	31437	Grus	—	—	1
“	24925	Telescopium	—	—	1
“	2965	Horologium	—	—	1
“	14743	Carina	—	—	1
“	24897	Sagittarius	—	—	1
“	8161	Canis Major	—	—	1
“	18839	Centaurus	—	—	1
“	8034	Carina	—	—	1
“	4974	Cælum	—	—	1
“	1932	Eridanus	—	—	1
“	28702	Capricornus	—	—	1
“	24650	Telescopium	—	68	1
“	28593	Capricornus	—	68	1
“	32240	Tucana	—	—	1
“	30830	Grus	—	132	1
“	7817	Dorado	—	132	1
“	8808	Canis Major	—	—	1
“	19593	Hydra	—	68	1
“	24120	Sagittarius	X	184	1
“	22012	Norma	γ^1	184	1
“	15293	Carina	—	184	1
“ Pec.	9021	Canis Major	δ	40, 185	2
“ Pec.	15266	Carina	x	40, 186	1
“ Pec.	15755	Centaurus	o^1	40,157,187	1
“ Pec.	16039	Centaurus	—	40, 187	1
G	H.P. 932	Auriga	α	—	3

Class.	Cat. No.	Constellation.	Des.	Remarks.	Prs.
G	336	Hydrus	β	—	3
“	19825	Centaurus	α^1	188	3
“	13336	Carina	l	—	2
“	6344	Lepus	β	—	2
“	10225	Puppis	ξ	189	2
“	30395	Grus	μ^1	—	1
“	21849	Scorpius	ω^2	190	1
“	21939	Triang.Aust.	δ	—	1
“	9199	Volans	γ^1	191	1
“	14569	Vela	x	189, 192	1
“	18202	Centaurus	m	—	1
“	20783	Lupus	ν^2	—	1
“	1174	Phœnix	ν	—	1
“	16100	Centaurus	—	—	1
“	22185	Triang.Aust.	ζ	—	1
“	9664	Puppis	—	—	1
“	30425	Grus	—	—	1
“	30133	Indus	—	—	1
“	12600	Vela	—	—	1
“	*19406*	Centaurus	—	225	1
“	9323	Canis Major	—	—	1
“	30378	Grus	—	—	1
“	15975	Centaurus	—	—	1
“	32359	Phœnix	—	—	1
“	10215	Puppis	—	—	2
“	27452	Sagittarius	—	—	1
“	24848	Pavo	—	132	1
“ Pec.	29382	Capricornus	ζ	193	2
G Comp.	31442	Aquarius	c^3	194	2
G 5 K	4812	Reticulum	α	—	2
“	27468	Pavo	δ	—	2
“	17129	Corvus	β	—	2
“	14751	Vela	μ	—	2
“	18121	Hydra	γ	—	2
“	15786	Hydra	ξ	—	2
“	29426	Capricornus	b	—	2
“	7731	Columba	δ	—	2
“	31263	Grus	ζ	—	2
“	1905	Eridanus	χ	—	1
“	31385	Aquarius	c^1	—	1
“	11852	Vela	d	—	1
“	13455	Vela	m	109	1
“	26206	Corona Aust.	β	—	2
“	27272	Sagittarius	ω	195	1
“	27332	Sagittarius	A	—	1
“	25853	Sagittarius	ν^1	196, 197	1
“	30405	Grus	μ^2	—	1
“	21710	Norma	η	—	1
“	8573	Carina	A	196	1
“	30647	Grus	δ^1	—	1
G 5 K	11714	Pyxis	β	—	1
“	25297	Corona Aust.	θ	—	1
“	28782	Microscop.	γ	—	1
“	25108	Sagittarius	—	198	1
“	10343	Puppis	a	—	1
“	3623	Eridanus	e	—	1
“	1998	Fornax	π	—	2
“	1931	Phœnix	—	—	1
“	16162	Musca	—	—	1
“	21630	Lupus	—	—	1
“	23206	Scorpius	—	—	1
“	17949	Centaurus	—	—	1
“	10512	Puppis	—	—	1
“	9697	Carina	—	—	1
“	12590	Carina	—	—	2
“	27380	Pavo	—	68	2
“	20044	Hydra	—	—	1
“	30557	Tucana	—	—	1
“	26134	Corona Aust.	—	165	1
K	355	Phœnix	α	—	3
“	22731	Scorpius	ε	—	3
“	H.P. 2400	Boötes	α	—	3
“	24596	Sagittarius	γ	—	2
“	H.P. 1459	Gemini	β	—	3
“	6884	Lepus	δ	—	2
“	19129	Centaurus	θ	199	2
“	1024	Phœnix	β	199	2
“	1462	Phœnix	δ	199	2
“	28213	Indus	α	199	2
“	31445	Grus	ι	199	2
“	22170	Apus	γ	199	2
“	20572	Lupus	ζ	199	2
“	*14910*	Carina	u	199, 222	2
“	5187	Eridanus	υ^2	199	2
“	4006	Eridanus	y	199	1
“	1924	Hydrus	η^2	199	1
“	18376	Centaurus	d	199	1
“	18700	Centaurus	M	199	1
“	21207	Lupus	ψ^1	199	1
“	24703	Telescopium	ε	199	2
“	28544	Microscop.	α	199	1
“	626	Phœnix	μ	199	1
“	31184	Piscis Aust.	δ	199	1
“	3034	Eridanus	τ^2	199	1
“	20721	Lupus	f	199	1
“	14955	Carina	T	199	1
“	10203	Volans	ζ	—	1
“	31431	Aquarius	c^2	—	2
“	26102	Sagittarius	o	—	2
“	26149	Sagittarius	τ	—	2

Class.	Cat. No.	Constellation.	Des.	Remarks.	Prs.	Class.	Cat. No.	Constellation.	Des.	Remarks.	Prs.
K	57	Phœnix	ϵ	—	2	K	24818	Corona Aust.	—	—	1
"	26162	Corona Aust.	δ	—	1	"	16847	Musca	ζ^1	—	1
"	4256	Eridanus	g	—	2	"	14817	Chamæleon	δ^1	—	1
"	25140	Telescopium	ζ	—	1	"	20034	Octans	π^1	—	1
"	2851	Eridanus	ι	—	1	"	17300	Centaurus	w	—	1
"	22393	Apus	β	—	1	"	27273	Pavo	μ^1	—	2
"	6915	Pictor	γ	—	1	"	27298	Pavo	μ^2	—	2
"	27239	Sagittarius	ι	—	1	"	14504	Carina	t^1	—	1
"	4757	Horologium	α	—	2	"	12782	Carina	k	199	1
"	25383	Pavo	ζ	—	1	"	2824	Hydrus	μ	—	1
"	3009	Fornax	β	—	1	"	12617	Vela	l	—	1
"	25927	Sagittarius	ξ^2	—	2	"	11624	Carina	e^2	61	1
"	9206	Volans	γ^2	191	1	"	11583	Vela	C	—	1
"	6427	Columba	ϵ	—	2	"	15222	Carina	z	—	1
"	8568	Puppis	τ	—	2	"	17366	Crux	ι	—	1
"	25171	Sagittarius	λ	—	2	"	18192	Musca	ι^1	—	1
"	6896	Columba	β	—	2	"	18920	Centaurus	—	—	1
"	31676	Aquarius	b^1	—	2	"	19179	Centaurus	—	—	1
"	7120	Columba	η	—	2	"	7011	Columba	ξ	—	1
"	6098	Columba	o	—	1	"	20654	Circinus	ϵ	—	1
"	7586	Columba	κ	—	1	"	6925	Pictor	—	—	1
"	14963	Antlia	ι	—	1	"	20948	Lupus	—	—	1
"	28615	Indus	β	—	2	"	28918	Microscop.	—	—	1
"	29533	Octans	ν	—	2	"	26780	Telescopium	ι	—	1
"	21051	Triang.Aust.	ϵ	—	1	"	18268	Centaurus	—	—	1
"	10984	Puppis	h^2	—	1	"	32376	Octans	θ	—	1
"	5807	Cælum	γ	171	1	"	15877	Centaurus	—	—	1
"	5137	Eridanus	υ^1	—	2	"	25257	Sagittarius	—	—	1
"	30930	Grus	ρ	—	1	"	10001	Puppis	—	—	1
"	22075	Norma	γ^2	—	1	"	11201	Volans	—	—	2
"	12372	Vela	c	—	1	"	22293	Apus	—	68	1
"	27075	Sagittarius	f	—	1	"	2016	Phœnix	χ	68	1
"	31591	Sculptor	γ	—	1	"	24745	Pavo	—	—	1
"	32333	Phœnix	π	—	1	"	18918	Centaurus	—	—	1
"	24987	Sagittarius	δ	—	2	"	13028	Vela	—	—	1
"	19931	Centaurus	c^1	—	1	"	17061	Musca	—	—	1
"	23841	Scorpius	Q	—	1	"	23835	Ara	—	—	1
"	19128	Hydra	π	—	2	"	24649	Sagittarius	—	—	1
"	7066	Dorado	—	—	1	"	15215	Carina	—	—	1
"	12868	Hydra	G	—	1	"	965	Phœnix	—	—	1
"	6119	Dorado	θ	—	1	"	25037	Sagittarius	—	—	1
"	4211	Reticulum	β	—	2	"	14105	Vela	—	—	1
"	16615	Corvus	ϵ	—	2	"	27354	Sagittarius	—	—	1
"	16179	Centaurus	B	—	1	"	31826	Phœnix	—	—	1
"	11405	Chamæleon	θ	—	1	"	15619	Centaurus	—	—	1
"	10249	Puppis	Q	—	1	"	544	Cetus	—	—	1
"	23958	Pavo	η	—	2	"	608	Cetus	—	—	1
"	30968	Grus	η	—	1	"	2853	Hydrus	—	—	1
"	25876	Sagittarius	ν^2	—	1	"	3116	Hydrus	—	—	1
"	11407	Volans	β	—	2	"	3588	Eridanus	—	—	2

Class.	Cat. No.	Constellation.	Des.	Remarks.	Prs.	Class.	Cat. No.	Constellation.	Des.	Remarks.	Prs.
K	20181	Hydra	—	—	1	K 2 M	20100	Hydra	E	—	1
"	6466	Columba	—	—	1	"	24958	Pavo	ξ	—	1
"	*8227*	Puppis	—	229	1	"	H.P. 333	Aries	α	—	3
"	9755	Puppis	—	—	1	"	17506	Centaurus	e	—	1
"	10705	Puppis	—	—	1	"	12006	Pyxis	γ	—	1
"	13440	Vela	—	—	1	"	8629	Canis Major	o^1	203	2
"	7410	Pictor	—	—	1	"	12930	Antlia	ϵ	—	1
"	20686	Lupus	—	—	1	"	19284	Octans	δ	—	1
"	24321	Scorpius	—	—	1	"	19455	Hydra	k	—	1
"	16878	Musca	—	—	1	"	16835	Crux	ϵ	—	2
"	19007	Octans	—	132	1	"	30209	Grus	λ	—	1
"	20478	Lupus	—	—	1	"	22941	Ara	ϵ^1	—	1
"	*20566*	Lupus	—	200	1	"	3171	Hydrus	ν	—	1
"	23459	Ara	—	—	1	"	9135	Puppis	—	—	1
"	23577	Ophiuchus	—	—	1	"	23378	Apus	ζ	—	1
"	25560	Sagittarius	—	—	1	K 5 M	H.P. 797	Taurus	α	—	3
"	25587	Sagittarius	—	—	1	"	30105	Indus	ϵ	—	1
"	25869	Pavo	—	165	2	"	10113	Puppis	c	—	2
"	26119	Corona Aust.	—	—	1	"	13030	Vela	N	—	2
"	26191	Corona Aust.	—	165	1	"	22832	Scorpius	ζ^2	—	2
"	6931	Columba	—	—	1	"	22916	Ara	ζ	—	2
"	27442	Sagittarius	—	—	1	"	4550	Reticulum	ι	—	1
"	28557	Capricornus	—	—	1	"	21886	Apus	δ^2	204	2
"	11191	Puppis	w	—	1	"	22672	Ara	η	—	2
"	18039	Musca	—	—	1	"	20793	Lupus	ϕ^1	—	2
"	8551	Puppis	—	—	1	"	14673	Carina	w	—	1
"	23603	Ara	—	—	1	"	19826	Centaurus	α^2	188	2
"	25454	Pavo	—	—	1	"	8839	Canis Major	σ	—	2
"	12613	Vela	—	132	1	"	*9288*	Puppis	π	205, 232	2
"	20184	Libra	—	—	1	"	12438	Vela	λ	205	2
"	30810	Piscis Aust.	—	132	1	"	14054	Carina	q	205	2
"	10769	Vela	—	201	1	"	10901	Puppis	h^1	205	1
"	28648	Capricornus	—	—	1	"	4940	Eridanus	d	205	2
"	1973	Phœnix	—	—	1	"	5816	Lepus	ϵ	—	2
"	26557	Sagittarius	—	—	1	"	19851	Apus	α	206	2
"	18720	Centaurus	—	—	1	"	21153	Lupus	ω	206	1
"	21090	Libra	—	—	1	"	14266	Antlia	α	206	1
"	31012	Grus	—	68	1	"	24919	Sagittarius	—	206	1
"	6674	Mensa	γ	68	1	"	31734	Aquarius	b^2	—	2
"	13451	Vela	—	—	1	"	1411	Phœnix	γ	207	2
K Comp.	11285	Carina	ϵ	202	2	"	9652	Puppis	σ	—	2
K 2 M	21146	Libra	υ	—	2	"	30261	Piscis Aust.	υ	—	1
"	22607	Triang. Aust.	α	—	2	"	16133	Musca	μ	—	1
"	30422	Tucana	α	—	2	"	762	Hydrus	λ	—	1
"	24179	Scorpius	G	—	2	"	10025	Puppis	—	—	1
"	17693	Musca	δ	—	2	"	27440	Sagittarius	—	—	1
"	23516	Ara	β	—	2	"	5850	Pictor	η^2	—	1
"	4121	Eridanus	h	—	1	"	14156	Vela	r	—	2
"	27289	Sagittarius	b	—	1	"	15571	Centaurus	—	—	1
"	4840	Reticulum	ϵ	—	1	"	9845	Carina	Q	—	1

Class.	Cat. No.	Constellation.	Des.	Remarks.	Prs.	Class.	Cat. No.	Constellation.	Des.	Remarks.	Prs.
K 5 M	*14558*	Carina	t^2	208	1	Ma	17843	Musca	—	—	1
"	9247	Canis Major	—	169	1	"	24218	Scorpius	—	—	1
"	1895	Cetus	—	206	1	"	10641	Carina	—	—	1
"	32337	Sculptor	—	—	1	"	26532	Sagittarius	—	—	1
"	21102	Lupus	—	—	1	"	6358	Orion	—	—	1
"	14478	Carina	r	—	1	"	1962	Cetus	—	—	1
"	*15986*	Hydra	—	209	1	Ma Comp.	22314	Scorpius	α	212	3
"	16484	Chamæleon	κ	68	1	Mb	17048	Crux	γ	—	2
"	28510	Indus	ζ	—	1	"	20431	Libra	σ	—	2
"	14405	Carina	—	—	1	"	377	Sculptor	η	—	1
"	12635	Vela	—	210	1	"	4545	Reticulum	γ	—	1
"	9205	Canis Major	—	—	1	"	27430	Sagittarius	c	—	1
"	10316	Puppis	—	132	1	"	30657	Grus	δ^2	—	1
"	9283	Puppis	—	132	1	"	21881	Apus	δ^1	204	2
"	5351	Cælum	—	—	1	"	24888	Sagittarius	η	—	2
"	30468	Tucana	—	68	1	"	3607	Eridanus	τ^4	—	2
Ma	4353	Hydrus	γ	—	3	"	1864	Phœnix	ψ	—	1
"	H.P. 482	Cetus	a	—	3	"	15344	Carina	—	—	1
"	1965	Cetus	υ	—	2	"	28656	Microscop.	—	—	1
"	H.P. 1091	Orion	α	211	3	"	30709	Tucana	ν	—	1
"	4487	Reticulum	δ	—	1	"	18566	Centaurus	—	—	1
"	14557	Chamæleon	γ	—	1	"	7557	Dorado	η^2	—	1
"	28951	Capricornus	A	—	1	"	9255	Canis Major	—	—	1
"	28598	Capricornus	ω	—	1	"	27330	Pavo	—	—	1
"	12728	Pyxis	θ	—	1	"	16139	Hydra	—	—	1
"	22454	Scorpius	H	—	1	"	14566	Carina	—	68	1
"	12652	Carina	g	—	2	"	30913	Grus	β	213	3
"	16793	Centaurus	F	—	1	"	18779	Centaurus	g	214	1
"	24348	Scorpius	—	—	1	"	16761	Musca	ε	214	1
"	27496	Telescopium	ξ	—	1	"	19014	Apus	θ	214	1
"	13506	Hydra	—	—	1	Md	9197	Puppis	L^2	215	2
"	15962	Centaurus	—	—	1	"	13073	Carina	R	216	2
"	8739	Puppis	—	—	1	"	13882	Carina	S	217	1
"	15777	Hydra	—	—	1						

REMARKS.

1. A. G. C. 14204. This object is a gaseous nebula. The only photograph taken, X 4087, is poor. The image consists of a well marked bright band, wave length 5007.0, and a faint bright band, Hγ, 4340.7.
2. η Carinæ. This spectrum is very peculiar. It presents a combination of dark lines and bright bands such as has not been found in any other spectrum examined in this series. The combination is such that a composite type of spectrum is suggested. Taking only the dark lines into consideration, the spectrum would be classed F 5 G, Remark 40. Considering only the bright lines, there is a marked resemblance to the spectrum of Nova Aurigæ, as photographed on X 3929, taken February 17, 1892. Different aspects appear on different plates. On the best plates, the system of dark lines is well defined and the bright bands are not numerous. On some plates, the dark lines appear inconspicuous, and nearly the whole spectrum is crossed by bright bands. On other plates, dark lines are distinctly seen on the edges of shorter wave length of the bright bands. The dark lines as seen on X 4709 resemble very nearly in wave lengths and intensities those in ι^1 Scorpii, and similar spectra, of Class F 5 G. A list of these lines as found in ϵ Aurigæ, is given in the seventh column of Table VII. Lines in η Carinæ near 4227.0 appear to differ slightly from those in ι^1 Scorpii and ϵ Aurigæ, but the faintness of η Carinæ at the present time renders an exact comparison of all the lines difficult. On the plates showing the dark lines clearly, bright bands are seen on the edges of greater wave length of the hydrogen lines Hδ, Hγ, and Hβ. The line Hβ is not seen as a distinct dark line, and the bright band extends from 4861.5 to a dark line which appears to be the solar line 4871.8. This band is brightest and most sharply defined on the edge of greater wave length. In all the images of this spectrum, the band Hβ is more intense than any other bright band. The lines Hδ and Hγ are distinctly dark and well defined. The bright band in the region of Hγ extends from Hγ, 4340.7, to the double dark line 4370.0 and 4371.5, and is crossed by the dark line 4352.0. This band is about 0.6 as intense as the band Hβ. The bright band in the region of Hδ extends from Hδ, 4101.8, to the dark line 4110.4, and is 0.8 as intense as the band Hβ. The lines K and Hϵ are broad and dark as in Class F 5 G. The space between two well defined dark lines is also frequently brighter than the continuous spectrum. Several photographs of this spectrum show very narrow images. On these plates, as many as 20 bright bands of various intensities are seen in the region extending from Hϵ to 4922. These bands bear a striking resemblance, as has been stated, in intensity and wave length, to the bright bands in Nova Aurigæ. The hydrogen lines Hϵ, Hδ, and Hγ also resemble the same lines in Nova Aurigæ, in being dark with bright bands on the edges of greater wave length.
3. A. G. C. 14965. The image is narrow. Hγ and Hβ are bright. No dark lines are seen.
4. A. G. C. 14971. The image examined is narrow. Hδ, Hγ, and Hβ are bright, with no appearance of dark edges. The lines 4026.4 and 4471.8 appear to be bright.
5. γ Velorum. See p. 243.
6. θ Muscæ. The bright band 4633 is present as in Class Oa. The lines Hϵ, Hδ, Hγ, and Hβ are dark. The more intense Orion lines of Class B are present and dark, except 4649.2, which, if present, would be concealed by the bright band 4633. The spectrum, therefore, appears to resemble that of ϵ Orionis of Class B, except for the presence of the bright band 4633. The lines are hazy. The spectrum of A. G. C. 17839, magnitude 8¼, which precedes $0^s.14$, and is south 6″.6, is not seen.
7. A. G. C. 8631. See pp. 147 and 248.
8. A. G. C. 14691. A bright band, which appears to be 4688, is seen on a faint continuous spectrum.
9. A. G. C. 14684. This spectrum differs in several particulars from that of A. G. C. 22763, the typical star. The lines K and Hϵ are dark, of nearly equal intensity, and narrow as in spectra like those of l Puppis and α Cygni of Class A 2 F. The lines Hδ and Hγ appear to be slightly dark, and both have a bright line or band on the side of greater wave length. Hβ is bright, but, as in the spectrum of η Carinæ (See Remark 2), it is shifted towards the edge of greater wave length, so that when the dark lines K and Hϵ are superposed on the same lines in any other spectrum, the bright Hβ in this star has greater wave length than Hβ in the superposed star. The brightness of the hydrogen lines is not more than 0.1 as intense as the bright band 4688. The line 4059 is nearly 2.0 as intense as in A. G. C. 22763, the typical star. The additional hydrogen lines 4200.7 and 4542.4 are not distinctly seen, but their presence is suspected. The line 4089.2 is present, and bright on the edge of greater wave length.
10. A. G. C. 14626. This spectrum is very nearly like that of A. G. C. 14684 (See Remark 9). Faint bright bands are, however, certainly present at 4514.5 and 4542.4, as in A. G. C. 22763, the typical star. The line 4116.2 is bright, or bright-edged on the side of greater wave length.
11. ζ Puppis. See pp. 148 and 233.
12. A. G. C. 22748. The bright band 4688 is about 0.5 as wide, and 0.5 as intense, as in A. G. C. 9311, the typical star. The line Hβ is not clearly seen in any photograph, so far obtained, of this spectrum, but it appears to be a very faint dark line, which is slightly bright on the edge of greater wave length. The image of this spectrum

from Hδ to the end of greater wave length appears on X 8476 taken with two prisms for ζ^2 Scorpii. The line 4514.5 is here bright on the edge of shorter wave length, and a bright line at about 4490 is present. Band 4633 is widely double.

13. A. G. C. 22843. The line Hβ is distinctly bright and is shifted towards the end of greater wave length, as in the spectrum of A. G. C. 14684 (See Remark 9). If the edge of shorter wave length of this bright Hβ is dark, it is not distinguishable from the continuous spectrum. The lines Hδ and Hγ are dark with bright edges on the side of greater wave length. The separation of band 4633 into two bright lines, as in the typical star, is well seen on Plate X 8476. The appearance is that of a double reversal, the bright band being divided into two portions by a dark line which is superposed. On this plate, lines 4471.8 and 4514.5 are distinctly bright on the edge of greater wave length.
14. A. G. C. 17572. Line 4685.4 is faint, and 4514.5 is 1.5 as intense as in τ Canis Majoris, the typical star.
15. ι Orionis. The Orion lines appear fainter than in the typical star, but the plate is not of the best quality.
16. θ^1 Orionis. The two series of hydrogen lines are seen in this image, but other lines, if present, are lost in the spectrum of the nebula, which is superposed. The spectrum of the nebula consists of bright bands, the most intense of which is at 5007.0. This band seems to extend to the hydrogen line Hβ, and bright bands of less intensity appear to coincide with Hε, Hδ, and Hγ.
17. A. G. C. 14811. The image is narrow, and the Orion lines of Class Oe 5 B are not seen.
18. The lines are broad and ill defined.
19. ζ and δ Orionis. The principal Orion lines have the same intensities as in ε Orionis, but many of the fainter lines are less intense or absent. 29 Orion lines are counted in ζ Orionis between the lines K and Hβ, while the same region of ε Orionis shows 61 lines. The additional hydrogen lines, 4200.7, 4542.4, 5414, and line 4685.4, are twice as intense in these spectra as in that of ε Orionis. Two lines of greater wave length than 5414 are present in both of these spectra, and are photographed on the isochromatic plates X 8119 of δ Orionis and X 8115 of ζ Orionis. Approximate wave lengths were found for these lines by estimating their position with regard to adjacent solar lines in the spectrum of α Aurigæ, on X 8109, upon which the above-named plates were superposed. One of these lines is dark, with intensity 2, and has the approximate wave length 5588. The other is a faint bright line, intensity 1, and has the approximate wave length 5695.
20. A. G. C. 22626. Line 4116.2 is about 0.7 as intense as in ε Orionis, the typical star.
21. δ Scorpii. The additional hydrogen line 5414 is photographed in this spectrum on Plate X 8743. Lines 4200.7, 4542.4, 4685.4, and 5414 have the same intensities as in ε Orionis, the typical star. This spectrum, however, resembles that of β Centauri, Class B 1 A, in the intensities of 4089.2, 4116.2, and 4649.2. Several plates show hazy lines, and this star is perhaps a spectroscopic binary.
22. τ Scorpii. Line 4685.4 is nearly as intense as in the spectrum of τ Canis Majoris of Class Oe 5 B. 4649.2 is no more intense than in β Centauri of Class B 1 A. The intensities of 4089.2 and 4116.2 are intermediate between the same lines in ε Orionis and β Centauri.
23. θ Carinæ. Line 4685.4 is approximately as intense as in τ Canis Majoris of Class Oe 5 B. 4649.2 is unusually faint. It is not more than 0.2 as intense as in ε Orionis, the typical star, and is even less intense than 4641.1 in θ Carinæ. The additional hydrogen line 5414 is photographed on the isochromatic plate, X 9184.
24. The image is neither distinct nor bright enough to show the faint Orion lines. 4089.2, 4116.2, and 4649.2 have, however, the same intensities as in ε Orionis.
25. A. G. C. 6481 and 6482. These spectra are superposed. Owing, however, to their difference in declination, the hydrogen and Orion lines of the two stars are well separated. When two spectra of nearly equal brightness are superposed, it is difficult to detect the relative intensities of the fainter lines so as to decide the exact class to which each spectrum belongs. While, therefore, both these spectra are of the Orion type, and are probably in this class, one or both may belong to Class B 1 A.
26. A. G. C. 22814. On X 6598 the line 4649.2 appears to be slightly bright on the edge of greater wave length.
27. The line K is twice as intense as in ε Orionis, the typical star
28. A. G. C. 22824. The spectrum of A. G. C. 22822, magnitude 7½, which precedes $1^s.49$ and is north 1′27″.4, is superposed, and appears also to belong to Class B.
29. The image is faint, and Hβ is not clearly seen.
30. The lines are slightly narrower than in β Centauri, the typical star. 4641.1 is double.
31. β Crucis. Lines 4089.2 and 4116.2 are a little more intense than in the spectrum of β Centauri, the typical star. On X 3976, 4387.8 and 4471.8 appear to be slightly bright on the edge of greater wave length.
32. α Crucis. The spectra of α^1 and α^2 Crucis are superposed. The magnitudes, according to the Argentine General Catalogue, are 1½ and 1¾ respectively, and the separation is $0^s.78$ in right ascension and 3″.4 in declination. There is no evidence on the plates examined that the spectrum is that of a double star, except that the lines are somewhat wide and hazy. It appears that both stars have similar spectra.
33. γ Aræ. Line 4089.2 is less intense, and 4649.2 more intense, than in β Centauri, the typical star. The faint lines are as numerous as in the typical star, in which respect this spectrum differs from those of Class B, which have wide lines, and in which few faint lines are seen (See Remark 19). The lines are very wide on some plates, and at times they appear double. This star may be a spectroscopic binary.
34. J Puppis. The end of shorter wave length of this spectrum appears on X 8039 and X 8174, taken with two prisms, for A. G. C. 10534. On these plates the lines in J Puppis appear double. Accordingly, additional photographs were secured in Peru. Two of these plates show indistinct doubling of the lines, but the evidence

is not yet conclusive as to whether this is due to focus or to a binary system.

35. β Scorpii. This spectrum appears on the edge of Plate X 5921, taken for ω^1 Scorpii. To confirm the classification, plates taken with the 11-inch Draper telescope in Cambridge were examined. On Plate C 2702, taken with 3 prisms, May 20, 1890, exposure 125^m, lines 4026.4, Hδ, 4144.0, Hγ, 4387.8 and 4471.8 are double, the fainter components being of shorter wave length than the more intense components. On C 6779, taken with 2 prisms, May 10, 1894, exposure 123^m, the spectrum of β Scorpii appears from line 4144.0 to the end of greater wave length. On this plate, lines 4387.8 and 4471.8 appear double, the fainter components being of greater wave length than the corresponding more intense components. On other plates, the lines are hazy. This star may be a spectroscopic binary. The spectrum of the adjacent star, A. G. C. 21806, magnitude 7½, which follows $0^s.40$ and is north 13″.8, is not seen, and is probably too faint to affect the spectrum of β Scorpii on plates taken with two or three prisms. Additional photographs of this spectrum are being secured.

36. A. G. C. 6538. The image is poor and the spectrum may belong to Class B 2 A.

37. The image is rendered indistinct by the nebula of Orion.

38. A. G. C. 6469 and 6471. These spectra are superposed. Both spectra are probably of Class B 1 A, although they may be of Class B 2 A.

39. θ Aræ and ε Canis Majoris. Lines K, 3994.9, 4531.4, and 4603.7 are 2.0 as intense, 4415.1, 4417.5, 4619.8, 4630.6, and 4641.1 are 1.3 as intense, 4237.4, 4242.6, 4254.1, 4267.4, and 4350.1 are 1.2 as intense as in β Centauri.

40. The lines are narrow with sharp edges. The intensities of some lines differ from those in the typical star.

41. A. G. C. 10534. This star, which is the Algol variable, V Puppis, has been found to be a spectroscopic binary. The period $1^d.454$ satisfies the observations of the changes in light, and of the varying separation of the lines in its spectrum. The spectrum has been examined on 61 plates, on 23 of which the lines are double. When the lines are well separated, the two components of each double line are seen to differ in intensity, the lines of the brighter component being 1.5 as intense as the corresponding lines of the fainter component. On 15 plates, the fainter lines have greater wave length than the more intense lines; on 8 plates they have shorter wave length. The following lines are found double: 3819.2, Hη, Hζ, Hε, 4009.5, 4026.4, Hδ, 4120.5, 4144.0, Hγ, 4387.8, 4471.8, Hβ, and 4922.1. The hydrogen lines Hκ, Hι, and Hθ, are very wide. Besides the lines of hydrogen, the helium lines 3819.2, 4009.5, 4026.4, 4120.5, 4144.0, 4387.8, 4471.8, and 4922.1 are present in both spectra. In addition to these lines, others are present which have not been found double. These are 4069.4, 4072.0, 4075.9, 4089.2, 4641.1, 4649.2, and 4685.4, which are present in the spectrum of the brighter component. From the intensities of these lines, together with those of the hydrogen and helium lines already mentioned as being present in the spectrum of the brighter component, it appears that this spectrum is of Class B 1 A. The spectrum of the fainter component appears to be of Class B 3 A. The separation is very large, and micrometric measures give the relative velocity of the two components as 610 km.

42. This spectrum is like that of ζ^1 Scorpii in the intensities of the Orion lines (See Remark 43). The lines, however, are not so narrow as in ζ^1 Scorpii.

43. ζ^1 Scorpii. Hβ consists of a dark line, bright on the edge of greater wave length. The bright portion is well defined and appears like a distinct bright line with an intensity equal to 0.2 of the bright line, Hβ, in the spectrum of μ Centauri. Hγ is dark with a bright edge on the side of greater wave length, which is wider, but a little less intense, than the bright line, Hβ. The other hydrogen lines are narrow and wholly dark. All the lines in this spectrum are narrow and unusually well defined. In this respect it differs essentially from the spectra of the greater number of the stars of the Orion type having bright hydrogen lines. This spectrum differs also from that of the typical star, β Centauri, in the intensities of some of the Orion lines, and nearly resembles the spectrum of θ Aræ (See Remark 39). 4350.1 is, however, more intense than in θ Aræ, and is about 0.5 as intense as Hγ, so that on plates taken with one prism, Hγ has the appearance of being double. This line, 4350.1, appears to reach its maximum intensity in this spectrum, and in those of A. G. C. 22297 and k Scorpii, A. G. C. 23098. 4619.8 and 4630.6 are also slightly more intense than in the spectrum of θ Aræ, and form a well marked pair like that at 4641.1 and 4649.2. 4267.4 and 4712.8 are slightly less intense than in θ Aræ, while 4009.5 is unusually faint, having an intensity not more than 0.3 as great as in θ Aræ or β Centauri.

44. β Lupi. This star has been found to be a spectroscopic binary, but the material is not yet sufficient to determine the period. The changes in width in the lines are easily seen by comparisons with the lines in the spectrum of the adjacent star, κ Centauri, which is photographed, either partly or wholly, on nearly all the plates of β Lupi. The lines in β Lupi are double on Plate X 7586, taken June 10, 1896, with an exposure of 80^m. The lines in the spectrum of κ Centauri are very sharply defined on this plate, as on all others where it appears. On X 8572, taken May 24, 1897, with an exposure of 56^m, the lines in β Lupi are as narrow as those in κ Centauri on the same plate. Several plates show the lines in β Lupi to be hazy.

45. ζ Centauri. This star is a spectroscopic binary, with a period of $8^d.024$. The spectrum appears on 67 plates, taken between June 17, 1892, and August 21, 1899. The lines are double on 25 plates. The lines of the brighter component are 1.5 as intense as those of the fainter. On 11 plates the fainter lines have shorter wave length, and on 11 plates they have greater wave length than the corresponding lines of greater intensity. On 3 plates, where the separation is slight, the difference

in intensity could not be detected. The Orion lines, 4009.5, 4026.4, 4120.5, 4144.0, 4387.8, 4471.8, and 4922.1 are distinctly double. The width of the hydrogen lines makes their doubling indistinct. The fainter Orion lines of Class B 2 A, which are present in the spectrum of the brighter component, are not seen double, but this may be due to their faintness. If these lines do not belong to both spectra, the spectrum of the fainter component is of Class B 3 A. If these lines are really common to both spectra, the spectra of both components are alike.

46. π Scorpii. This star is a spectroscopic binary, with a period of $1^{d}.571$. The spectrum has been examined on 56 plates, taken during the period of time from August 12, 1892, to August 26, 1899. The lines are double on 30 plates. The difference in intensity between the lines of the two spectra is greater than in the other spectroscopic binaries photographed in this series. The lines of the brighter component are about 3.0 as intense as those of the fainter component. On 16 plates the fainter lines have greater wave length, and on 14 plates they have shorter wave length than the corresponding lines of greater intensity. The Orion lines, 4009.5, 4026.4, 4120.5, 4144.0, 4387.8, and 4471.8 are the lines that are usually seen distinctly double, but frequently the components of the hydrogen lines Hδ, Hγ, and Hβ can be separated. The fainter Orion lines of Class B 2 A are present in the spectrum of the brighter component. None of these lines are intense enough in the fainter component to be visible, if present. If these lines are not present in the spectrum of the fainter component, that spectrum is of Class B 3 A; if they are present, both spectra are of Class B 2 A.

47. μ Centauri. The lines Hε, Hδ, Hγ, and Hβ are bright. No spectrum of the Orion type has been photographed in this series showing a greater number of bright hydrogen lines than that of μ Centauri, or showing greater intensity of the bright line, Hβ. Dark edges to this line are faintly seen. The bright line, Hγ, lies towards the edge of shorter wave length of the dark band on which it is superposed. Hι, Hθ, Hη, and Hζ are wholly dark, broad, and hazy. Besides the bright lines due to hydrogen, several other bright lines are present in this spectrum. The two most conspicuous are at wave lengths 4232 and 4584 approximately, and these are not more than 0.1 as intense as Hβ. Line 4387.8 is bright on the edge of shorter wave length. A diffuse bright band appears on the side of shorter wave length of the faint dark line 4531.4. The dark line 4553.4 is superposed on a bright band. The dark line 4619.8 is superposed on a faint bright band. 4922.1 and 5015.8 are bright on the edge of greater wave length.

48. κ Canis Majoris. The lines Hε, Hδ, Hγ, and Hβ are bright. Hβ appears to be wholly bright, or to have extremely faint dark edges on either side. Hε, Hδ, and Hγ consist of broad dark bands, on which narrow bright lines are superposed. The bright lines Hδ and Hγ, are not centrally superposed on the dark bands, but lie nearer the edge of shorter wave length. The dark band Hζ appears darkest in the centre and fades away towards both edges. The space between the lines 4641.1 and 4649.2 is brighter than the continuous spectrum, and other bright lines are present, but not so well marked as in μ Centauri (See Remark 47). 4120.5 and 4144.0 are slightly bright on the edge of greater wave length.

49 o Puppis. Hγ and Hβ are bright, superposed on dark bands. The lines are unusually wide and hazy. The Orion lines are only a little darker than the adjacent portions of the spectrum.

50. On some plates where the definition is sharp, faint traces of the triple line 4069.4, 4072.0, and 4075.9, and also of 4641.1 and 4649.2 are seen.

51. η Lupi. The lines in this spectrum are hazy on several plates, and on X 9512, X 9521, X 9870, and X 9948, lines 4120.5, 4387.8, and 4471.8 appear double. The spectrum of A G. C. 21655, magnitude 7¾, which follows $0^{s}.56$, and is north 15″.6, is not seen.

52. o Velorum. The spectrum of A. G. C. 11761 is superposed. The lines Hδ, Hγ, and Hβ of A. G. C. 11761 are almost lost in the spectrum of o Velorum, while the lines Hθ, Hη, Hζ, and Hε are prominent at the end of shorter wave length. The line Hε of A. G. C. 11761 falls upon Hι of o Velorum, thus giving that hydrogen line an appearance of unusual intensity. No lines are perceived as belonging to A. G. C. 11761 except those of hydrogen, hence its spectrum can not be classified with certainty, although as the line K is not seen, it is probably of the Orion type. With the dispersion of two prisms, the spectrum of A. G. C. 11761 is lost.

53. μ Crucis and A. G. C. 17542. These spectra are superposed. The fainter spectrum of A. G. C. 17542 is seen apart from that of μ Crucis only as a small portion on the following side of the image. Owing, however, to the difference in declination, the hydrogen lines of the two spectra are well separated. The spectrum of μ Crucis is like that of α Pavonis of Class B 3 A, except that the helium line 3819.2 is slightly intensified by the superposition of Hη of A. G. C. 17542. In the latter spectrum, the following lines are seen: Hβ, which is bright; Hζ, Hε, Hδ, and Hγ, which are unusually wide; 4009.5, 4026.4, and 4471.8, which are of the same intensity as in spectra of Class B 3 A. While, therefore, the fainter Orion lines in this spectrum are lost in the image of μ Crucis, it appears certainly to be of Class *B 3 A*.

54. τ^1 and τ^2 Lupi. These spectra are partly superposed.

55. ρ Scorpii. The line 3994.9 is 1.2 as intense as in α Pavonis, the typical star.

56. b^1 Carinæ. The faint spectrum of A. G. C 12224, magnitude 7¼, which follows $4^{s}.94$, and is north 11″.3, is partly superposed. This spectrum is of the first type.

57. The portion of the spectrum containing Hβ is not photographed.

58. The line 4120.5 is less intense than in α Pavonis, the typical star.

59. λ Crucis. The lines appear double on several plates, and this star may be a spectroscopic binary.

60. f Centauri. The line 4481.4 is as intense as in the spectrum of φ Velorum of Class B 5 A.

61. e^1 and e^2 Carinæ. These spectra are partly superposed.

62. k Puppis, and A. G. C. 9881. These spectra are almost completely superposed. The difference in declination is so slight that the hydrogen lines of the two spectra are barely separated, but owing to the difference in right ascension, the following side of the image contains only the lines of A. G. C. 9881, and the preceding side, only those of k Puppis. The characteristic lines of Class B 3 A are well marked in the spectrum of A. G. C. 9881; k Puppis is probably of Class B 8 A.

63. A. G. C. 10861. This spectrum is completely superposed on that of γ Velorum, except a narrow portion on the preceding side.

64. A. G. C. 9334. The image is fairly good, but Hβ is not distinctly seen.

65. A. G. C. 10566 and 10568. These spectra are almost completely superposed. However, the difference in right ascension is such that the preceding side of the image shows only the lines of A. G. C. 10566, and the following side only those of A. G. C. 10568.

66. A. G. C. 10973. The spectrum of A. G. C. 10974, magnitude 7.0, which follows $0^s.51$, and is south 1′6″.1, is superposed on this spectrum, and the wide lines, Hζ, Hε, Hδ, Hγ, and Hβ, of the fainter star are seen.

67. A. G. C. 24839. Hβ is not seen as a dark line, and may be bright. The lines Hε, Hδ, and Hγ are broad, with some of the haziness usually seen in spectra of the Orion type having Hβ bright. Superposed on this spectrum are the lines Hζ, Hε, and Hδ of A. G. C. 24840, magnitude 8½, which follows $0^s.79$, and is south 11′26″.7. The line Hδ of this fainter star crosses the spectrum of A. G. C. 24839 near Hβ, at about the wave length 4761, and is a well marked line. It thus appears that the absence of Hβ as a dark line in the spectrum of A. G. C. 24839 is not due to the faintness of the image at the end of greater wave length.

68. The image is poor, but the spectrum probably belongs to this Class.

69. A. G. C. 9900 and 9902. These spectra are partly superposed.

70. J Centauri and A. G. C. 18172. These spectra are partly superposed. The spectrum of A. G. C. 18172 is faint, and is classified from a small portion showing on the preceding side of J Centauri.

71. A. G. C. 11024. The line Hβ appears to be bright on the only plate so far obtained of this spectrum. The image, however, is faint and the observation needs to be confirmed.

72. A. G. C. 14656. Lines Hδ and 4922.1 appear slightly bright on the edge of shorter wave length. This effect may be due to the sharply defined edges of the lines.

73. μ^1 Scorpii. This star is a spectroscopic binary, having a period of $34^h\,42^m.5$. The two spectra appear to be alike, and both belong to Class B 3 A, but the lines of one are more intense than those of the other. Besides the lines of hydrogen, the following helium lines are sometimes found to be double: 4009.5, 4026.4, 4120.5, 4144.0, 4387.8, and 4471.8. The lines are well separated on 51 of the 91 plates examined. On 30 of these plates, the lines of the fainter component have greater wave lengths than those of the brighter component, and therefore faint lines appear on the less refrangible side of each of the stronger lines. On 18 plates, the lines of the fainter component have shorter wave lengths than those of the brighter component. On 3 plates, the lines appear approximately equal. The separation is large, and micrometric measures give the relative velocity of the two components as 460 km. The relative intensity of the lines of the two stars appears to vary. On a few plates, the lines are of nearly equal intensity, but frequently the stronger lines are twice as intense as the fainter lines. When the less intense lines have greater wave length, the difference in intensity is greater than when they are of shorter wave length. The estimates in the former case are that the stronger lines have from 1.5 to 2.0 times the intensity of the fainter lines; in the latter, from 1.1 to 1.5. There is thus probably a variation in the light of one or both of the components.

74. δ Centauri. Hδ, Hγ, and Hβ are bright, superposed on dark bands. Hδ and Hγ lie slightly towards the edge of shorter wave length of the broad dark bands on which they are superposed. These dark bands are probably complex. On some plates the edge of shorter wave length of bright Hδ appears like a distinct dark line, superposed on the hazy dark band. On Plate X 8332, a trace of a dark line superposed on the bright line Hγ is seen. The bright lines 4232, 4531, 4553, and 4584 are present, but fainter than in μ Centauri (See Remark 47). The isochromatic plate X 9197 shows the end of greater wave length of this spectrum. Line 4922.1 is wholly dark. 5015.7 is bright and superposed on a faint, dark band. 5047.8 is dark. Three faint bright lines have approximate wave lengths, 5167, 5275, and 5312.

75. α Aræ. The lines in this spectrum are very broad in all the photographs, and on several plates they appear to be double. Hβ consists of a well marked bright line superposed on a hazy, dark band which produces wide edges on each side of the bright line. On Plate X 8792, these dark edges appear double. A faint double reversal is barely seen as a fine dark line superposed on the bright Hβ. Hγ is doubly reversed. This phenomenon is excellently photographed on some plates of this spectrum. On a very wide and hazy dark band, a faint bright band is superposed. This bright band has a sharply defined, moderately wide, dark line centrally superposed on it. This central dark line makes the bright portion look like two distinct bright lines. From an examination of the various plates, it appears as if there are slight changes in the line Hγ in this spectrum, but it is not yet certain whether these changes are real or dependent upon the quality of the photograph. For instance, slight changes in the intensity of the two portions of the bright Hγ are noted. On X 9231, the portion of greater wave length is very faint; on X 9302, the portion of greater wave length is more intense than that of shorter

wave length; on X 9545, the portion of greater wave length is not seen. No brightness is seen in the line Hδ, but it appears to be triple, the central line being narrow and the outer lines hazy. It should perhaps be stated that Hγ has a somewhat similar, although more marked, triple appearance on a few plates where the bright lines are of approximately the same intensity as the continuous spectrum. The Orion lines are the same as in those spectra of Class B 3 A which have broad lines, and they show no bright edges. The bright lines 4232, 4531, 4553, and 4584 are less conspicuous than in the spectrum of μ Centauri.

76. ω Canis Majoris. Hδ, Hγ, and Hβ are bright. The intensity of the bright Hδ is so slight that it merely gives to the dark band on which it is superposed the appearance of being double. The bright lines 4232, 4531, 4553, and 4584 are not distinctly seen in this spectrum.
77. v^1 Puppis. Double reversals of the hydrogen lines Hγ and Hβ are found in this spectrum. This effect is best seen in Hγ. The underlying dark band is wide, and sometimes the edges appear to be double. The bright line superposed on this dark band is narrow, and has centrally superposed on it a fine dark line. The line Hδ shows a very faint bright line superposed on a broad, dark band which appears triple. Line 4471.8 is bright on the edge of greater wave length.
78. r Puppis. Hδ, Hγ, and Hβ are bright, superposed on dark bands. The Orion lines are faint.
79. E Carinæ. Hβ consists of a narrow line, only slightly brighter than the continuous spectrum, superposed on a wide, dark band. The other hydrogen lines are wide and dark.
80. A. G. C. 17717. Hγ and Hβ are bright. The dark Orion lines are faint, and traces of dark lines not present in spectra of Class B 3 A are seen. Numerous bright spaces or lines are seen, and the faint dark lines may be spaces between these bright lines. Line 4120.5 is barely seen. 4387.8 is bright on the edge of greater wave length. The bright lines at wave lengths 4232, 4531, 4553, 4584, and 4619 are well marked. The dark lines accompanying the second, third, and fifth of these lines in the spectrum of μ Centauri, and described in Remark 47, are not seen in this spectrum.
81. Hβ is bright.
82. A. G. C. 8991. On plate X 6232, the line Hβ in this spectrum appears to be bright. The spectrum, however, is rather faint at the end of greater wave length, and, to confirm this observation, several plates were taken with the 11-inch Draper telescope in Cambridge. On plates C 11754 and C 11771, taken February 4 and February 14, 1899, with exposures of 120^m and 118^m respectively, the line Hβ is bright.
83. η Centauri. This spectrum is composite, with the line Hβ variable. The brighter spectrum belongs to Class B 3 A, the characteristic helium lines of that class being well marked. The fainter spectrum is of Class A, or A 2 F. The helium lines are always broad on the 34 plates examined, and frequently they appear to be double or triple. This effect seems to be due to superposed solar lines belonging to the fainter spectrum. The hydrogen lines Hδ and Hγ are generally narrow, but, on a few plates, they appear to be hazy, although not so broad as the helium lines. On the greater number of the plates, the peculiar combination of narrow hydrogen lines and broad helium lines is presented. Numerous solar lines are distinctly seen, and traces of many others are visible. These lines agree in wave length and relative intensity with lines in the spectrum of α Cygni, and have been identified by superposing plates of η Centauri on X 7990, a photograph of α Cygni taken with two prisms. The wave lengths of the following lines found in the spectrum of η Centauri, are taken from Table VII, page 80: 4163.9, 4173.6, 4179.5, 4233.6, 4300.2 to 4302.6, 4315.2, 4344.7, 4352.0, 4482.0, 4489.6 to 4491.6, 4501.5, 4508.5, 4515.4, 4520.3 to 4522.9, 4541.6, 4549.7, 4556.0, 4584.0, 4586.1, 4619.2, 4629.9, and 4634.8. Many of these lines are well marked on some plates and barely seen on others, but the change in their intensity may be due to the quality of the plate. The line K is not more intense than in the typical star, α Pavonis, of Class B 3 A. On most of the plates, the region of the line K is hazy. On a few plates there appears to be a trace of the line K, narrow, sharply defined, but distinguishable through the general haziness of the region. While the secondary spectrum can not be classified with certainty, it appears to belong to Class A, or A 2 F, and to have narrow lines of well marked intensity, as found in spectra to which remark 40 applies.

The most remarkable peculiarity in the spectrum of η Centauri is the variation of the hydrogen line Hβ. In studying this variation, the spectrum was carefully examined by several different methods; first, the plates were intermingled and a brief description of Hβ, including estimates of its intensity with respect to Hγ, was read off to a recorder. At other times, the plates were superposed on each other, to detect, if possible, any variation in the position of the solar lines with respect to the hydrogen or helium lines, or to determine whether small differences are real or instrumental. Again, the plates were superposed on those of other spectra to identify certain lines, and to compare intensities of lines. No positive changes in the position of the solar lines with respect to those of hydrogen and helium could be detected by the method here employed. The changes in Hβ are complex, and can not yet be explained with certainty. It will be noticed, however, that many of the appearances may be explained if we assume that Hβ is narrow and dark in the fainter component, and that it is bright and variable in the brighter component.

A description of the general appearance of the spectrum on each plate is given below, preceded by the number of the plate, the date, and the length of exposure. All these plates were taken with two prisms except X 4156 and X 5759, which were taken with one prism.

X 4156. June 21, 1892. 6^m. Hβ is dark, slightly hazy, 0.2 as intense as Hγ. All lines are slightly hazy.

X 5759. July 30, 1894. 30^m. Hβ is dark, sharply defined, 0.2 as intense as Hγ, and slightly bright on the edge of greater wave length. The hydrogen lines, Hδ and Hγ, are narrow, and the Orion lines are broad.

X 7508. May 14, 1896. 60^m. Hβ is dark, hazy, and 0.8 as intense as Hγ. All lines are broad. Hδ, Hγ, and 4387.8 appear indistinctly double.

X 8493. April 30, 1897. 77^m. Hβ is dark, well defined, nearly equal to Hγ, and has a very faint bright edge on the side of shorter wave length. Hε, Hδ, and Hγ are well defined on the edge of shorter wave length, and hazy on the edge of greater wave length. The faint solar lines are well seen.

X 8505. May 4, 1897. 78^m. Hβ is dark, well defined, nearly equal to Hγ, and has a very faint bright edge on the side of greater wave length.

X 9052. April 30, 1898. 39^m. Original record of the exposure of this plate says "Clock stopped." There are accordingly several very narrow spectra on the plate. Hβ appears to consist of three dark lines, the central one, which is the most intense, being about 0.3 as intense as Hγ. All the lines are broad, perhaps double.

X 9053. April 30, 1898. 38^m. Hβ consists of two dark lines, the one towards the red, which is the more sharply defined, being about 0.2 as intense as Hγ. The space between these two lines is a little brighter than the continuous spectrum. Upon superposing this plate on X 9052, it appears that, of the three lines seen at Hβ on the latter plate, the one having the greatest wave length is not visible on X 9053. All the lines are wide.

X 9141. May 25, 1898. 72^m. Hβ is dark, well defined, and 0.3 as intense as Hγ. Both edges of Hβ are slightly bright. The Orion, and the faint solar lines are broad.

X 9162. May 27, 1898. 54^m. Hβ is dark, and 0.2 as intense as Hγ. A faint, hazy, dark line is seen near Hβ, towards the violet. The space between this line and Hβ is slightly bright. A very faint line is also seen in the same position with respect to Hγ. These may be solar lines, but the solar lines are, in general, very indistinct on this plate. The helium lines, 4120.5, 4144.0, and 4387.8 are double.

X 9194. June 11, 1898. Two exposures, 60^m and 55^m, respectively. Isochromatic plate. Hβ is not distinctly seen, on account of faintness of the image in that region. All the lines are broad.

X 9207. June 15, 1898. 60^m. Hβ appears to be doubly reversed. The appearance is best described by supposing a faint, hazy, dark band having superposed on it a faint bright band, which in turn has a well defined dark line superposed. This central dark line is about 0.1 as intense as Hγ, and divides the bright band into two bright lines. The edges of the underlying dark band appear like indistinct dark lines. Hγ is well defined, with a wide haziness on the side of greater wave length. The Orion lines are broad. The solar lines are well seen, and rather narrow.

X 9224. June 18, 1898. 64^m. Hβ consists of two dark lines, separated by a bright line or space. The dark line towards the red is better defined and slightly more intense than the one towards the violet. When this plate is superposed on X 9207, the central dark line of Hβ on the latter plate falls on the dark line towards the red on X 9224. The solar lines are not clearly seen. Hδ and Hγ are well defined, but surrounded by haziness. The Orion lines are broad.

X 9280. July 12, 1898. 66^m. Hβ is dark, sharply defined, 0.2 as intense as Hγ, and is superposed on a faint bright band. Two indistinct dark lines are seen near Hβ, towards the violet, and one towards the red. The Orion lines are broad. Numerous faint solar lines are present. Hγ is well defined, but several adjacent hazy lines are seen towards the red.

X 9290. July 19, 1898. 78^m. Hβ consists of two dark lines, both of which are bright on the edge of greater wave length. The dark line towards the red is sharply defined, 0.4 as intense as Hγ, and corresponds to the central dark line of Hβ, on X 9207, when the two plates are superposed. The dark line towards the violet is about 0.2 as intense as Hγ, and is not so well defined as the one towards the red. The bright edge or line towards the violet is also less sharply defined than the one towards the red. The solar lines are numerous, 4233.6 being unusually well marked, and much narrower than the helium lines. Hδ and Hγ are narrow, with hazy lines adjacent to them.

X 9312. August 19, 1898. 48^m. The spectrum is very narrow on this plate. Hβ is dark, single, and 0.7 as intense as Hγ. There is no appearance of bright edges to Hβ. The helium lines 4387.8 and 4471.8 appear to be double. Hδ and Hγ are fairly well defined. The image is too dense to show the solar lines distinctly.

X 9495. May 19, 1899. 64^m. The appearance of Hβ on this plate is that of a double reversal. The central dark line is sharply defined, and 0.1 as intense as Hγ. The bright band on which this line is superposed is very faint. The underlying dark band appears like an indistinct line on each edge. It is of interest that the faint bright lines or spaces at wave lengths 4232, 4553, 4584, and 4619, approximately, which are present in most spectra of the Orion type having bright hydrogen lines, are distinctly photographed on this plate. The solar lines are distinctly seen.

X 9499. May 20, 1899. 70^m. Hβ appears to be doubly reversed. The central dark line is narrow, and 0.3 as intense as Hγ. The bright band is equally intense on each side of this central dark line. The underlying dark band appears like a hazy line on each side. The solar lines are very distinct on this plate. 4344.7 and 4352.0 are distinctly seen near Hγ. The Orion lines are very broad.

X 9505. May 22, 1899. 50^m. Hβ is almost invisible. Two or three very faint dark lines are glimpsed, the most intense of which is not more than 0.05 as intense as Hγ. All the lines are broad or hazy, and the solar lines are indistinct.

X 9510. May 23, 1899. 54^m Hβ appears to be doubly reversed. The central dark line is narrow, and 0.3 as intense as Hγ. The Orion lines are broad, and the solar lines are well marked and rather narrow.

X 9515. May 24, 1899. 53^{m}. Hβ is dark, sharply defined, 0.2 as intense as Hγ, and superposed on a bright band. The brightness on the edge of shorter wave length of the dark Hβ is slight, that on the edge of greater wave length is more intense and appears like a narrow bright line. Traces of an underlying dark band are seen, but not distinctly. Hδ and Hγ are single and well defined. The solar lines are distinctly seen.

X 9519. May 25, 1899. 61^{m}. Hβ is dark, sharply defined, 0.3 as intense as Hγ, and superposed on a faint bright band. The portions of the bright band are equally intense on each side of the dark line. Traces of an underlying dark band are very indistinctly seen. Hδ and Hγ are narrow. The solar lines are well marked. The helium line, 4471.8, is very wide, while the adjacent line, 4481.4, is narrow.

X 9523. May 26, 1899. 42^{m}. Hβ is dark, sharply defined, 0.3 as intense as Hγ, and superposed on a faint, bright band, which is equally intense on each side of the dark line. Traces of an underlying dark band are faintly seen. The helium lines are broad or double. The solar lines, as well as the hydrogen lines Hδ and Hγ, are narrow.

X 9527. May 27, 1899. 89^{m}. The spectrum on this plate resembles that on X 9499.

X 9531. May 29, 1899. 46^{m}. Hβ appears to be doubly reversed. The central dark line is narrow, and 0.4 as intense as Hγ. The bright band is more intense on the edge of greater wave length of this dark line, than on that of shorter wave length. The underlying dark band is very indistinct and hazy. Hγ appears to be bright on the edge of greater wave length. The solar lines are clearly seen.

X 9539. May 30, 1899. 36^{m}. Hβ is dark, 0.1 as intense as Hγ, and no bright edges are seen. A hazy dark line is seen near Hβ on the side of shorter wave length. The solar lines are distinctly seen, and are a little hazy. Hγ is narrow. The Orion lines are broad or double.

X 9548. May 31, 1899. 58^{m}. Hβ is dark, 0.4 as intense as Hγ, and has a distinct bright edge on the side of greater wave length. The edge of shorter wave length of Hβ is also bright, but it is very faint. Traces of faint, hazy, dark lines are seen on each side of the bright edges of Hβ. The Orion lines are broad. Hδ, Hγ, and the solar lines, are narrow.

X 9576. June 5, 1899. 61^{m}. Hβ appears to be doubly reversed. The dark central line is 0.3 as intense as Hγ. The bright band is equally intense on each side of the dark line. The underlying dark band is distinctly seen on each side of the bright lines. Thus Hβ appears to consist of three dark lines, of which the central one is the most intense, and which are separated by bright spaces. Hδ, Hγ, and the solar lines, are narrow. The Orion lines are broad.

X 9583. June 6, 1899. 45^{m}. Hβ presents a complex appearance on this plate. A narrow, dark line, 0.4 as intense as Hγ, is superposed on a faint bright band. On the outer edges of the bright line or band towards the violet are two dark lines, and towards the red is one dark line. Hδ and Hγ are narrow, as are also the solar lines.

X 9602. June 9, 1899. 47^{m}. Hβ consists of two dark lines with a bright space between. The dark line towards the violet is more sharply defined, is 0.4 as intense as Hγ, and corresponds to the central dark line of Hβ on X 9207, when the two plates are superposed. Traces of one or two very indistinct dark lines are seen on the side of shorter wave length of the sharply defined dark Hβ. Hγ is narrow. The solar band, extending from 4383.7 to 4385.2, is separated from the helium line 4387.8.

X 9609. June 10, 1899. 35^{m}. Hβ consists of three dark lines, of which the central line is more sharply defined and slightly more intense than the outer lines. This central line is 0.2 as intense as Hγ. The space between this line and the dark line of greater wave length appears like a bright line. The solar lines are distinctly seen. Hγ is narrow. The helium lines are broad.

X 9619. June 12, 1899. 61^{m}. Hβ appears to be doubly reversed. The central dark line is narrow, and 0.4 as intense as Hγ. The line K is distinctly seen on this plate. It is narrow and faint, having intensity 2. In other respects the spectrum on this plate agrees with that on X 9207.

X 9666. June 19, 1899. 40^{m}. Hβ is almost invisible, but appears to consist of three extremely faint dark lines with spaces slightly bright. The solar lines are indistinct and faint.

X 9861. July 25, 1899. 62^{m}. Hβ is dark, narrow, 0.5 as intense as Hγ, and bright on the edge of greater wave length. Hγ is slightly bright on the edge of greater wave length. The Orion lines are very wide.

X 9911. August 7, 1899. 45^{m}. Hβ appears to be doubly reversed. The central dark line is narrow, and 0.5 as intense as Hγ. The bright band on which this dark line is superposed is more intense towards the red. The underlying dark band appears like a hazy line on each edge. The solar lines are well marked and narrow.

84. κ Eridani. Lines 3918.7, 3920.6, 3926.8, and K are not seen, which does not appear to be due to poor definition as 3819.2 is well defined. 4009.5, 4120.5, 4267.4, and 4712.8, are fainter than in ϕ Velorum, the typical star.

85. α Eridani. On a few plates, Hβ appears to be double, or to have a faint bright line superposed centrally on the wide dark band, as in the spectrum of α Columbæ. This observation, however, needs confirmation. The line K is less intense than line 3926.8. The lines are very wide and hazy.

86. Lines 4128.5, 4131.4, and 4481.4, are somewhat more intense than in the spectrum of ϕ Velorum, the typical star. 4481.4 is estimated as 0.8 as intense as 4471.8, and the lines 4128.5 and 4131.4, when seen together, are about equal to 4144.0.

87. ε Normæ. The spectrum of A. G. C. 22244, magnitude 7, which precedes $0^s.81$ and is north 20″.2, is superposed. A narrow portion of this faint spectrum appears on Plate X 6865, and the broad hydrogen lines Hδ, Hγ, and Hβ, are seen as in spectra of the first type.

88. ε Volantis. No trace is seen of the spectrum of A. G. C. 10924, magnitude 8, which follows $0^s.46$ and is north 7″.4.

89. Lines 4128.5 and 4131.4, when seen together, are about 1.5 as intense as in the spectrum of φ Velorum, the typical star.

90. A. G. C. 16939. This spectrum is superposed on the spectra of α^1 and α^2 Crucis, and a narrow portion of it only appears on the preceding side.

91. A. G. C. 11917. This spectrum resembles that of o^2 Canis Majoris in the intensity of line 3994.9.

92. A. G. C. 16566. The broad hydrogen lines Hδ, Hγ, and Hβ, of A. G. C. 16565, magnitude 8½, which precedes $0^s.43$ and is south 6′8″.5, are superposed on this spectrum.

93. A. G. C. 6182. This spectrum may be composite. A well marked line is present which identifies as the solar line 4233.6. This line is narrow, while the Orion lines are wide. 4481.4 is also narrow, but the adjacent helium line, 4471.8, is wide and hazy. Very faint lines are seen which appear to coincide with the solar lines 4173.6, 4179.5, 4300.8 to 4302.6, 4315.2, 4520.3 to 4522.9, 4549.7, 4556.0, and 4584.0 When, however, spectra are too faint to be photographed with more than one prism, it is difficult to distinguish between solar and Orion lines if they are faint and indistinct.

94. α Centauri. The line 3994.9 is well marked but not quite as intense as in o^2 Canis Majoris (See Remark 96). The spectrum may resemble that of o^2 Canis Majoris in the presence of faint Orion lines not usually seen in Class B 5 A, but they are not well defined. The spectrum is slightly peculiar in the extreme faintness of line 3926.8, which is barely seen, and in the increased intensity of the double line, 3918.7 and 3920.6, which together are 1.2 as intense as the line K.

95. ε Capricorni. This spectrum is probably composite and appears to show changes due to motion of one or more bodies. On Plate X 5692, taken July 14, 1894, with an exposure of 43^m, and on X 7157, taken September 18, 1895, with an exposure of 60^m, the hydrogen lines are narrow and sharply defined, while the line K and the Orion lines are wide and hazy. The hydrogen lines are as narrow as in spectra to which remark 40 applies, and the Orion lines are so wide that remark 18 would be used to describe them. It appears from an examination of these plates as if the two systems of lines proceed from different bodies, but no lines are seen except those present in the typical stars of Class B 5 A. Other plates show all the lines, including those of hydrogen, to be hazy, and in addition to the Orion lines of Class B 5 A, several solar lines are present. On X 10077, taken October 27, 1899, with an exposure of 75^m, two lines which appear to be the solar lines 4173.6 and 4179.5 are present, with almost as great intensity as the helium line 4144.0. The helium line 4387.8 is double. This may be due to the presence of the double solar line 4383.7 and 4385.2. On all the plates showing hazy hydrogen lines, the band containing the Orion lines 4415.1 and 4417.5 is more intense than on X 5692 and X 7157 mentioned above. This increased intensity may be due to the presence of the solar lines 4415.3 and 4417.9. A line is present which appears to be the solar line 4490.0. Traces of other faint lines are seen.

96. o^2 and η Canis Majoris. The more marked Orion lines have about the same intensity as in φ Velorum, the typical star, with the following exceptions: line 3964.6 is at least 2.0 as intense, and 4922.1 is 1.5 as intense as the same lines in φ Velorum, while 3994.9, which is very faint in φ Velorum, is in this spectrum about as intense as 4009.5. Besides the well marked Orion lines characteristic of Class B 5 A, the following lines are seen: 4069.4, 4072.0, 4075.9, 4553.4, 4568.6, 4576.5, 4591.6, 4598.2, 4619.8, 4630.6, 4641.1, 4649.2, with nearly as great intensity as in Class B 1 A. 4630.6 is here more intense than 4641.1 or 4649.2. The line K is 2.0 as intense as in the spectrum of φ Velorum.

97. α Columbæ. Hβ consists of a faint bright line only slightly more intense than the continuous spectrum, and superposed upon a broad dark band to which it gives a double appearance. The other lines of hydrogen are dark and wide.

98. p Carinæ. Hγ and Hβ are bright, superposed on dark bands. Hβ bright, and the dark band on which it is superposed, are slightly more intense on the edges of shorter, than on those of greater wave length. Hγ bright, lies towards the edge of shorter wave length of the dark band on which it is superposed. Double reversal is seen in the line Hβ, the bright line being crossed by a fine dark line. The Orion lines 4267.4 and 4712.8 are faint in this spectrum.

99. J Velorum. This spectrum shows the lines Hγ and Hβ variable. On Plate X 4710, taken June 2, 1893, with an exposure of 60^m, Hβ appears as a narrow, bright line superposed on a wide dark band, and has an intensity about 0.1 as great as that of Hβ in the spectrum of μ Centauri. Hγ shows a slight central brightness which gives it the appearance of being double. On plates X 6376, and X 7376, taken April 19, 1895, and March 17, 1896, with exposures of 60^m and 61^m respectively, all the lines are dark. On eight additional plates, taken in April and May 1899, all the lines are dark.

100. κ^1 Apodis. This spectrum shows marked changes. On Plate X 6794, taken June 27, 1895, with an exposure of 92^m, the line Hβ is almost invisible, but upon the most careful scrutiny it appears to be an extremely faint dark line with an equally faint bright edge towards the red. The lines Hε, Hδ, and Hγ are narrow and sharply defined, while the Orion lines 4009.5, 4026.4, 4120.5, 4128.5 to 4131.4, 4144.0, 4387.8, and 4471.8 are wide and hazy. Besides these well marked Orion lines, traces of fainter lines are seen on this plate, especially of 4649.2 which is not present in typical spectra showing

the above named Orion lines of the same intensity as in this spectrum. Lines 4415.1 and 4417.5 are also more intense than in Class B 5 A. On Plate X 6801, taken June 28, 1895, with an exposure of 78^m, the spectrum does not differ essentially from that on X 6794. On X 9596, taken June 8, 1899, with an exposure of 81^m, Hβ is bright on the edge of greater wave length, with intensity *1* on the scale of the estimates in Table XIX. All the other lines, including those of hydrogen, appear double on this plate. On X 9812 and X 9830, taken July 13, and July 17, 1899, with exposures of 75^m and 65^m, respectively, Hβ is bright, intensity *3*, and the other lines of the spectrum are double. On X 9877, taken July 27, 1899, the image is too faint to show Hβ distinctly. On this plate the Orion lines are not so wide as those of hydrogen. On X 9895, taken August 2, 1899, with an exposure of 77^m, Hβ is bright, with intensity *5*, and 4144.0, Hγ, 4387.8 and 4471.8 appear double.

101. A. G. C. 9181. The lines Hγ and Hβ in this spectrum are variable. On Plate X 4417, taken October 5, 1892, with an exposure of 55^m, these lines, as well as the other hydrogen lines, are dark. On X 6210, taken November 28, 1894, with an exposure of 42^m, Hβ is bright and superposed on a faint dark band. The intensity of Hβ is about 0.3 as great as that of bright Hβ in the adjacent star ω Canis Majoris. Hγ is wholly dark on this plate. On X 6432, taken April 27, 1895, with an exposure of 58^m, Hβ is bright, and is 1.2 as intense as Hβ in ω Canis Majoris. The image on this plate is too dense to show Hγ. On X 6455, taken April 30, 1895, with an exposure of 60^m, Hβ is bright, and 1.5 as intense as Hβ in ω Canis Majoris. Hγ is also bright on the latter plate. On X 8300, taken January 28, 1897, with an exposure of 61^m, Hβ is dark. In order to ascertain, if possible, the period of the variability of these hydrogen lines, a large number of photographs have been secured with the 11 inch Draper telescope at Cambridge. Plates taken in October and November, 1897, show Hβ bright, and varying from 0.1 to 0.5 of the intensity of Hβ in ω Canis Majoris. In December, 1897, this line was again dark, and in 37 photographs taken since December 1, 1897, Hβ is either distinctly dark or not clearly seen. In the latter case the plates are poor. The material is not at present sufficient to determine the period of the variability of this line. Lines 4415.1 and 4417.5 are more intense in this spectrum than in the typical spectra of Class B 5 A, and are about equal to the same lines in β Centauri of Class B 1 A.

102. γ Circini. The image is found to consist of two spectra so completely superposed that no difference either in right ascension or declination is perceived. The brighter spectrum is of Class B 5 A, the fainter, of Class F 8 G, or G. One star is therefore probably white or bluish in color, the other, yellow, and judging from the relative intensities of the two spectra, they must be nearly equal in magnitude. This composite spectrum is therefore an exception to the general rule that when double stars are of approximately equal magnitudes, they have similar spectra. In the brighter spectrum, the hydrogen series is seen from Hκ to Hβ inclusive, and 3819.2, 4009.5, 4026.4, 4120.5, 4128.5, 4131.4, 4144.0, 4471.8, 4481.4, and 4922.1 are present with about the same intensities as in φ Velorum, the typical star of Class B 5 A. The fainter image shows distinctly lines 4215.7, 4227.0, the band G, and 4326.0, characteristic of Class G. The line K is also seen as a faint haze, being almost obliterated by the bright part of the spectrum of the Orion star. The whole spectrum appears also to be crossed by numerous, indistinct, solar lines.

103. β^1 Sagittarii. A trace of the spectrum of the companion star, A. G. C. 26486, magnitude 7, which follows $2^s.54$ and is north 5″.6, is seen on Plate X 7093. The spectrum of A. G. C. 26486 is seen from Plate B 19946 to be of Class A 5 F, or F.

104. ν Puppis. Lines 3856.2 and 3863.2 are present in this spectrum, and 3819.2 and 4922.1 have slightly greater intensity than in the spectrum of γ Gruis, the typical star.

105. H. P. 625 and + 23° 558. These spectra are partly superposed. In H. P. 625, the Orion lines are rather faint and hazy. In Pleione, + 23° 558, Hβ is bright, and the Orion system of lines, while not completely defined, appears to be the same as in Class B 8 A.

106. The Orion lines, except 4026.4, are slightly fainter than in γ Gruis, the typical star.

107. l Centauri. The lines 4128.5, 4131.4, and 4144.0, are not so well defined as in the typical star, and traces of numerous lines are seen between Hδ and Hγ.

108. f Eridani. A. G. C. 4241 and 4242. These spectra are completely superposed. The difference in right ascension, $0^s.28$, is not sufficient to show any portion of one spectrum free from the image of the other. The hydrogen lines are wide, but show no separation. The line K, however, is double, the more intense component belonging to the fainter star A. G. C. 4241, which is south 8″.7. The spectrum of A. G. C. 4241 is probably of Class A, although the fainter lines are lost by the superposition of the spectrum of A. G. C. 4242, which is clearly of Class B 8 A. The presence of the two spectra is very easily proven by superposing the more intense line K on the line K in the spectrum of γ Gruis, the typical star of Class B 8 A, when it is observed that 4471.18 and 4481.4 do not match the same lines in the spectrum of γ Gruis. These lines in the two spectra do match, however, when the line K in γ Gruis is superposed on the fainter line K in the spectrum of A. G. C. 4242.

109. m Velorum and A. G. C. 13453. These spectra are partly superposed.

110. A. G. C. 14349. This spectrum may be of Class B 5 A

111. Line 4026.4 has the same intensity as in γ Gruis, but other Orion lines are not clearly seen.

112. β Orionis. The lines in this spectrum are very sharply defined. The relative intensity of the well marked Orion lines is similar to that in the spectra of Class B 8 A, and both the systems of Orion and solar lines are present. Many more lines are present, however, than in γ Gruis, the typical star, and the intensities of all the

lines, except those due to hydrogen, are greater than in γ Gruis. The hydrogen lines are not more than 0.5 as intense as in γ Gruis. 47 lines, in addition to those of hydrogen, have been measured in this spectrum, from Hι to wave length 5016. A list of these lines is given in Table XXV.

113. μ Sagittarii. This spectrum is like that of β Orionis, as far as can be determined by plates taken with one and two prisms.

114. X Eridani. The line 4471.8 is 1.4, or 1.5 as intense as in the spectrum of λ Centauri, the typical star.

115. κ^1 Volantis. The line 4471.8 is fainter than in the spectrum of λ Centauri, the typical star.

116. ω Fornacis. No trace is seen of the spectrum of the companion star, A. G. C. 2692, magnitude 8, which precedes $0^s.79$ and is south 5″.0.

117. β^1 and β^2 Tucanæ. These spectra are superposed. The difference in declination, however, is sufficient to show the two systems of lines well separated. The spectrum of β^1 Tucanæ shows wide hydrogen lines from Hλ to Hβ, and the Class, B 9 A, to which the spectrum belongs, is well defined. In the case of β^2 Tucanæ there are no well marked lines to assist in the classification, except K, and the lines of hydrogen, which are seen from Hη to Hβ. These lines are narrow and of about the same intensity as in α Cygni and l Puppis. The spectrum of β^2 Tucanæ is probably of Class A 2 F and has narrow lines.

118. κ Lupi and A. G. C. 20571. These spectra are superposed. The lines K, Hε, Hδ, Hγ, 4481.4, and Hβ of the fainter spectrum, A. G. C. 20571, are identified among the lines in the spectrum of κ Lupi. The spectrum of A G. C. 20571 is probably of Class A.

119. λ Telescopii. The line 4026.4 is slightly fainter than in λ Centauri, the typical star.

120. h^2 Sagittarii. All lines are very faint except those due to hydrogen.

121. φ Phœnicis. The line K is not seen distinctly in this spectrum. Traces of 4026.4 and 4481.4 are seen but no other lines are visible except those of hydrogen.

122. The hydrogen lines, K, and 4026.4, have the same intensity as in λ Centauri, but fainter lines are not seen.

123. A. G. C. 9589. The line K is as intense as in α Canis Majoris, Class A, but 4026.4 is present.

124. The line K is a little more intense than in α Canis Majoris, the typical star, and has 0.2 of the intensity of Hδ, but the solar lines in general appear to be less numerous, or less intense, than in the typical star.

125. On plates taken with two prisms the lines of hydrogen are wide and hazy, and 4481.4 is the only well marked solar line.

126. N Carinæ. The line K is even a little more intense than in α Canis Majoris, the typical star, but the solar lines are not seen except 4128.5, 4131.4, and 4481.4. 4026.4 is present, and faint traces of 4120.5, 4144.0, 4387.8, and 4471.8 are also seen. The lines are slightly narrower than in α Canis Majoris, the typical star.

127. A. G. C. 6141. The line K is 1.5 as intense as in α Canis Majoris, the typical star, while 4026.4 is well marked and fully as intense as in λ Centauri, Class B 9 A. The solar lines are, in general, faint. 4128.5, 4131.4 seen together, 4383.7 and 4385.2 seen together, and 4481.4 are well marked.

128. ψ Centauri. This spectrum resembles that of N Carinæ (See Remark 126), in the presence of line 4026.4.

129. α Geminorum. The spectra of the two components of this double star are not separated. The lines are wide, however, on the two plates examined.

130. ι Piscis Aust. Solar lines are not well seen except 4128.5, 4131.4, and 4481.4. The presence of 4026.4 is suspected.

131. ξ Lupi and A. G. C. 21587. These spectra are superposed, but the difference in right ascension between the two stars is sufficient to show the spectrum of ξ Lupi on the preceding side, and of A. G. C. 21587 on the following side. The line K, which is single on both edges of the image, is distinctly double in the centre where the two spectra are superposed. Both spectra appear to be of Class A.

132. This spectrum appears on the edge of the plates.

133. This spectrum is faint, and is classified from the relative intensity of the line K and the lines of hydrogen.

134. A. G. C. 9243. This spectrum is peculiar in the scarcity of lines. The image is well seen, from Hζ to Hβ. Line K is barely seen. 4128.5 and 4131.4, seen as one, are the most intense lines except those of hydrogen. Another well marked line appears to coincide with the additional hydrogen line, 4200.7, as found in spectra of classes Od, Oe, Oe 5 B, and B. Since, however, 4542.4 is not present, it is more probable that the line at 4200 is a solar line. The Orion line, 4026.4, is suspected to be present. 4077.9 and 4233.6 are faintly seen.

135. A. G. C. 17504. The lines 4128.5 and 4131.4 show increased intensity as in the spectrum of α Doradus. (See Remark 145.)

136. A. G. C. 21206. The faint lines, Hδ and Hγ, of A. G. C. 21205, magnitude 8¾, which precedes $1^s.02$ and is north 2′ 29″.3, are superposed on this spectrum.

137, This spectrum resembles that of τ^9 Eridani (See Remark 144) in the intensity of the double line, 4128.5 and 4131.4, but the line K is as intense as in the typical star, α Canis Majoris.

138. This spectrum resembles those of ν Fornacis and τ^9 Eridani in the intensity of the double line, 4128.5 and 4131.4, but other lines, except those of hydrogen, are not seen.

139. A. G. C. 19867. The intensities of some of the lines are like those in τ^9 Eridani. (See Remark 144.) Since, however, this spectrum appears on the edge of the plates and is not in the best focus, an exact comparison could not be made.

140. This spectrum is probably like that of α Doradus. (See Remark 145.)

141. α Andromedæ. This spectrum is peculiar. In the intensity of the hydrogen and calcium lines it resembles α Canis Majoris. The solar lines, however, are much less numerous than in the spectrum of Sirius, and several Orion lines are present, of which the most intense are

4026.4, 4267.4, and 4471.8. An exact study of all the lines in this spectrum was not attempted since the only plate in this series on which the spectrum appears is not very good.

142. β Aurigæ. This star is a spectroscopic binary with a period of $3^d.984$. Both components appear to be of equal, or nearly equal brightness, and to have similar spectra. On three of the four plates taken with the 13 inch Boyden telescope, the line K is double, and when the definition is good, Hδ, Hγ, and 4481.4, are also double.

143. ν Fornacis. This spectrum is peculiar in the faintness of the line K, which is barely seen on plates of normal exposure, and in the intensity of the double line 4128.5 and 4131.4, which together are three or four times as intense as any other line in the spectrum except those of hydrogen. 4077.9 is fairly well marked among the fainter lines.

144. τ^9 Eridani. This spectrum resembles that of ν Fornacis (See Remark 143), but appears to be more peculiar. The line K is not seen, while, in general, the solar lines are more intense than in α Canis Majoris, the typical star. The double line, 4128.5 and 4131.4, is 0.4 as intense as the line Hδ, and 4077.9 is 1.2 or 1.3 as intense as in α Canis Majoris. The absence of the line K is not due to faintness of the spectrum at the end of shorter wave length, for two lines are seen between Hη and Hζ. These lines appear to be the Orion lines 3856.2 and 3863.2, which are well marked in the spectrum of ϕ Velorum, Class B 5 A. 3863.2 appears double. 4026.4 and 4471.8 are present with nearly as great intensity as in the spectrum of λ Centauri, Class B 9 A.

145. α Doradus. This spectrum resembles that of ν Fornacis and of τ^9 Eridani, in the marked intensity of the double line 4128.5 and 4131.4, but differs from them in showing the line K nearly as intense as in α Canis Majoris, and in having fewer lines present. Except the lines of hydrogen, the following are the only lines that are well marked; 3856.2, 3863.2, the line K, and the double line 4128.5 and 4131.4. 3920.6 and 4471.8 are faintly seen.

146. L¹ Puppis. This spectrum is like that of α Doradus. (See Remark 145.)

147. θ^2 Microscopii. The lines, in general, are hazy and ill defined. The spectrum resembles that of α Doradus. The Orion lines 4267.4, 4387.8, and 4471.8 are present and narrow. Owing to the faintness of this star no lines of shorter wave length than K are seen except those due to hydrogen.

148. θ Eridani. The spectrum of A. G. C. 3224, magnitude 5½, which follows $0^s.82$ and is north $1''.1$, is superposed. The lines are a little hazy, but not separated. It is probable that both stars have similar spectra.

149. μ Piscis Austrini. The hydrogen lines are hazy and the solar lines are very faint and indistinct on all the plates, although in the adjacent star, τ Piscis Austrini, the lines are well defined.

150. A. G. C. 8592 and 8594. These spectra are partly superposed.

151. A. G. C. 32414. The faint spectrum of A. G. C. 32415, magnitude 7.4, which follows $2^s.72$ and is south $6' 46''.1$, is partly superposed. This spectrum appears to be of Class B 8 A.

152. A. G. C. 17472. This spectrum is not exactly in focus on the plates examined, but the intensities of the solar lines resemble those in the spectrum of ι Phœnicis.

153. The intensities of the lines resemble those in the spectrum of α Cygni, but the lines are not so narrow as in the latter spectrum.

154. α Cygni. Two plates of this spectrum have been taken with the 13 inch Boyden telescope. Plate X 4098, taken with one prism, is not very good. Plate X 7990, taken with two prisms, shows the spectrum from Hζ to about wave length 5020. A list of the lines in this spectrum, from Hκ to Hβ, is given in Table VII, column 6, of this volume. The spectrum differs from that of the typical star, ι Centauri, in the intensity of many of the lines. The line K is of approximately the same intensity as in ι Centauri, but the lines of hydrogen are only about 0.7 as wide as in the latter spectrum. The Orion lines, 3854.2, 3856.2, 3863.2, and 4471.8, are present, the latter being very faint. Only two lines of greater wave length than Hβ are seen. These are well marked and agree in position and intensity with the helium lines 4922.1 and 5015.7, as present in the spectra of the Orion stars. It appears far more probable, however, that these are solar lines. The spectra of ϵ Sagittarii, β Carinæ, and γ Centauri, of Class A, as photographed on isochromatic plates, show two lines in approximately the same positions as those in α Cygni. They are probably 4920.8 and 5014.5. Line 4227.0, which is well marked in ι Centauri, is barely seen in α Cygni.

155. 1 Puppis. This spectrum appears to be almost exactly like that of α Cygni, as far as can be determined with plates taken with one prism. The only difference that has been noted is that line 4491.6 is less intense than in α Cygni.

156. This spectrum is like that of α Cygni, as far as can be determined with plates taken with one prism.

157. o^1 and o^2 Centauri. These spectra are partly superposed on all the plates except X 6340, which is taken with narrow images, so that the two spectra are separated. Both spectra are peculiar in having narrow, sharply defined lines.

158. θ^1 Microscopii. This spectrum is peculiar. The faintness and haziness of the line K, which is not more than 0.1 as intense as Hδ, combined with the intensity of the solar lines, suggest a composite type. If this is the case, the secondary spectrum is probably of Class A, for there is no trace of the helium line 4471.8, which is present in all classes of Orion spectra. In general aspects, the spectrum resembles that of the peculiar star, δ Normæ, of Class A 3 F, but the line K is much less intense, and the solar lines are less numerous. 4077.9 is unusually intense, being 0.3 or 0.4 as intense as Hδ, and is sharply defined. Two lines between Hη and Hζ, which appear to be the solar lines 3856.5 and 3872.7, are better defined than the line K, and thus it appears that the hazi-

ness of the line K is not due to poor focus. A hazy line which probably includes the solar lines 3918.6 and 3920.4, is nearly as intense as the line K. 4172.9 is, next to 4077.9, the most intense solar line, and 4179.5 is present, but faint. 4215.7, 4383.7 to 4385.2, 4481.4 and 4490.0 are well marked. 4128.5 is 1.5 as intense as the adjacent line 4131.4. This may be due to the presence of 4128.1. Lines between Hε and Hδ differ in intensity from those in the typical star, ι Centauri, and there may be differences in wave lengths, but an exact comparison is difficult since this spectrum is too faint to photograph satisfactorily with two prisms. 3997.6 and 3998.1 which are present in ι Centauri, are not seen in the spectrum of θ^1 Microscopii.

159. ι Phœnicis. This spectrum closely resembles that of θ^1 Microscopii, but the line K is 2.0 as intense, and 4215.7 is also nearly 2.0 as intense as in the latter spectrum.

160. α Piscis Austrini. On some plates the lines are broad, and some lines appear to be double. On other plates, the lines are well defined.

161. The line 4077.9 is more intense than in the spectrum of τ^3 Eridani, the typical star, and the spectrum may resemble that of δ Normæ.

162. This spectrum resembles δ Normæ in the intensity of line 4077.9, but the intensity of the lines in general resembles more closely that of τ^3 Eridani, the typical star.

163. δ Normæ. This spectrum is very peculiar, and suggests a composite type. While the lines of hydrogen are as intense as in the typical star, τ^3 Eridani, and the line K is not more than 0.7 or 0.8 as intense as the line H, the solar lines resemble those of Class F 5 G. The type may be composite but the line K is well defined on both edges, instead of being hazy as is usual when the spectrum of a fainter star is superposed. 4077.9 is peculiarly intense and is fully 0.5 as intense as Hδ. The solar lines are nearly equal in intensity to those of α Canis Minoris of Class F 5 G, except that 4227.0 and 4415.3 are only about 0.5 as intense as in α Canis Minoris. The space between 4131.4 and 4172.9 appears like a faint bright band. In the intensity of 4077.9 this spectrum resembles the peculiar star, ζ Capricorni of Class G. 4240.0 is well marked.

164. The space between Hδ and 4172.9 appears like a faint bright band, and several other regions appear brighter than the continuous spectrum.

165. The image is faint.

166. α Circini. Line 4077.9, which may include 4076.8, is as intense as in Class F 5 G. 4215.7 is 1.5 as intense as in α Carinæ, the typical star, and is about equal to 4227.0. Several solar lines between Hγ and Hβ differ in intensity from those in α Carinæ. 4367.9 and 4469.5 are fainter than in α Carinæ, 4395.3 and 4400.2 to 4401.6, which are fairly well marked in α Carinæ, are not seen in α Circini. 4422.8, 4435.2, and 4455.0 are more intense than in α Carinæ.

167. ω Ophiuchi. This spectrum is very nearly like that of α Circini. (See Remark 166.) The line K, however, is about 0.8 as intense, and 4490.0 is 1.5 as intense as in the spectrum of α Circini. The space between 4131.4 and 4172.9 is bright, as in δ Normæ, and the spaces between 4077.9 and Hδ, and between Hδ and 4131.4 appear a little brighter than the continuous spectrum.

168. b Ophiuchi. This spectrum resembles that of ω Ophiuchi in having the line K less intense than H, and in having 4077.9 more marked than in the typical star. The lines are not very well defined, but in many cases they appear as intense as in the spectrum of α Canis Minoris of Class F 5 G. 4227.0, however, is no more intense than in Class F.

169. A. G. C. 9247 and 9250. These two spectra are superposed. The solar lines in the spectrum of A. G. C. 9250 are nearly lost among the more intense lines in the spectrum of A. G. C. 9247.

170. A. G. C. 21767. The broad lines Hε, Hδ, and Hγ of A. G. C. 21771, magnitude 7.1, which follows $4^s.30$ and is north 2′ 36″.8, are partly superposed on this spectrum.

171. A. G. C. 5810 and γ Cæli. These spectra are partly superposed. The spectrum of A. G. C. 5810 is faint.

172. The spectrum is faint, but it appears to resemble that of ξ Phœnicis.

173. ξ Phœnicis. This spectrum is very peculiar. If the type is composite, as is suggested by the combination of wide, hazy, hydrogen lines and several intense solar lines, the two classes of spectra are not readily distinguished. The lines Hδ, Hγ, and Hβ are as intense as in Class A, and are covered with a haze extending over the edges of the lines themselves. The lines K and H are as wide as in the stars of Class G. The end of shorter wave length is not seen beyond the hydrogen line Hη. The spectrum resembles the peculiar star ζ Capricorni of Class G, in the marked intensity of line 4077.9, and of 4215.7. It also resembles the peculiar star τ^9 Eridani of Class A, in the intensity of the double line 4128.5 and 4131.4. 4077.9, which may include 4076.8, is about 0.7 as intense as Hδ; 4215.7 is about 0.6 as intense as Hδ; and 4128.5 and 4131.4 together are 0.4 as intense as Hδ. 4435.2 is conspicuous among the fainter solar lines. The faintness of the star renders an exact comparison of the solar lines difficult, since on plates taken with two prisms, only the more intense lines are seen.

174. p Velorum. The line K is only about 0.9 as intense as the line H. The hydrogen lines Hδ, Hγ, and Hβ are as intense as in Class F. The solar lines are sharp and well defined.

175. m Hydræ. The lines are well defined and there is no trace of the spectrum of the companion star A. G. C. 19998, magnitude 7, which follows $0^s.58$ and is south 6″.8.

176. G Carinæ. Line 4077.9 has greater intensity than in the typical star, and is about equal to the same line in δ Canis Majoris, Class F 8 G.

177. The image is very narrow.

178. α Persei. The intensities of several lines in or near the band G are different from those in α Canis Minoris, the typical star. Lines 4294.3 and 4305.8 are 2.0 as intense as in the typical star. 4173.6 and 4179.5 are

also more intense than in α Canis Minoris, and the spectrum resembles the star δ Canis Majoris in the intensities of the above named lines.

179. β Doradus. In respect to the intensity of the lines Hδ, Hγ, and Hβ, and in the appearance of the lines of the band G, this spectrum resembles the typical star, ρ Puppis, but in respect to the bands K and H, the intensity of 4077.9, and several other well marked solar lines, there is a strong resemblance to the spectrum of δ Canis Majoris of Class F 8 G. The lines are not so sharp as in δ Canis Majoris. The lines 4294.3 and 4297.1 are intermediate in intensity between the same lines in ρ Puppis and in δ Canis Majoris.

180. This spectrum is like that of β Doradus. (See Remark 179.)

181. δ Volantis. This spectrum is like that of β Doradus, except that the lines 4294.3 and 4297.1 are less intense, and resemble the same lines in ρ Puppis, the typical star.

182. The solar lines are unusually intense. The double line 4161.7 and 4163.9, as well as 4233.6, 4294.3, and 4297.1 are 2.0 as intense as in the typical star, α Canis Minoris, while some lines present in the typical star, especially 4435.2, are absent or faint. The pair of lines, 4172.9 to 4173.6, and 4177.8 to 4179.5, are well marked, even on plates taken with one prism, as are also 4383.7 to 4385.2, 4395.3, 4400.2, and 4417.9. The lines in this spectrum agree with those in ε Aurigæ, for which a list is given in the seventh column of Table VII.

183 The line 4326.0 is 0.7 or 0.8 as intense as in α Fornacis, the typical star, and the intensity of the fine lines in the band G is intermediate between this and Class F 5 G.

184. The spectrum resembles that of δ Canis Majoris but the lines are not so sharp.

185. δ Canis Majoris. The lines are unusually narrow with sharp edges. The line Hγ is well separated from the solar line 4337.6, and Hβ is separated from 4855.7 on the side of shorter wave length, and from 4864.2 to 4866.5 on the side of greater wave length. The lines K and H are as wide as in α Boötis. The band G is not continuous. On plates taken with two prisms, the following lines are seen in this region, all distinctly separated; 4288.1, 4289.8, 4294.3, 4297.1, 4300.2, 4302.6, 4305.8, 4308.0, 4309.5, and 4315.2. The spectrum is crowded with lines and nearly all the solar lines are more intense than in the typical star. The intensities, however, do not appear to be so peculiar as in the stars, ι^1 Scorpii, b Velorum, and y Carinæ of Class F 5 G, in whose spectra the lines are narrow.

186. x Carinæ. This spectrum has not been photographed with more than one prism. It closely resembles the spectrum of δ Canis Majoris. The lines Hγ and Hβ appear somewhat fainter, and the fine lines more intense than in δ Canis Majoris.

187. The spectrum appears to be like that of δ Canis Majoris.

188. α^1 and α^2 Centauri. These spectra are almost completely superposed. The spectrum of the fainter star, which is α^2 Centauri, extends about 0.2 mm. on the preceding side of the image. This spectrum, probably owing to its red color, is not photographed well at the end of shorter wave length, and at this end, the spectrum of α^1 is seen alone. A few lines in the spectrum of α^1 are intensified by superposition of the lines of α^2, while others are made hazy and indistinct by the bright part of the spectrum of α^2. It is difficult to classify the spectrum of α^2 Centauri correctly, since so small a portion is seen apart from the spectrum of α^1. The spectrum of α^2 may more nearly resemble those of Class K, than of Class K 5 M, but the band G appears to be resolved into lines as in the latter class, and line 4227.0 appears to be nearly as intense as in α Tauri.

189. The line 4077.9 is 1.5 as intense as in α Aurigæ.

190. ω^2 Scorpii. In the intensity of the bright bands at wave lengths 4470 to 4525, and 4614 to 4648, and in the faintness of the end of shorter wave length, this spectrum resembles those of Class K.

191. γ^1 and γ^2 Volantis. These spectra are superposed. A faint, narrow, edge of γ^1 appears on the preceding side of the spectrum of γ^2.

192. x Velorum. On the best plates, the lines Hζ, Hε, Hδ, Hγ, and Hβ of A. G. C. 14573, are superposed on this spectrum, but on a plate taken with narrow images, the two spectra are separated.

193. ζ Capricorni. The lines of hydrogen are fully as intense as in α Aurigæ, while the bright bands 4470 to 4525, and 4614 to 4648, and the general absorption towards the end of shorter wave length are as marked as in Class K. 4077.9, which may have 4076.8 superposed, but which is seen as a single line, is unusually intense, being fully 2.0 as intense as Hδ. 4215.7 is also very intense, being 1.5 as intense as 4227.0. The two lines, 4077.9 and 4215.7, have been found to be unusually intense in the spectrum of ξ Phoenicis of Class F. Another strongly marked line probably includes the lines 4554.2 and 4556.0.

194. c^3 Aquarii. This spectrum is composite. It resembles that of α Aurigæ, except in the line K and the lines of hydrogen. Hγ and Hβ are as intense as in Class F 5 G. Hδ exceeds Hγ and Hβ in intensity and is equal to Hδ in Class F. The line K is not more than 0.5 as wide as H and Hε combined. H and Hε combined are wider than in Class G, and nearly equal to the same band in Class K. Hθ, Hη, and Hζ are broad, as in spectra of classes A to F. The peculiarities of this spectrum can be best explained by supposing a fainter spectrum belonging to Class A, or A 2 F, to be superposed upon a brighter spectrum of Class G.

195. ω Sagittarii. The line 4077.9 is only about 0.8 as intense as in α Reticuli, the typical star.

196. In the intensity of the lines Hδ, Hγ, and Hβ, this spectrum is intermediate between those of α Aurigæ and α Reticuli. 4077.9 is 1.5 as intense as in α Reticuli.

197. ν^1 Sagittarii. The spectrum of −22° 4906, which appears to be of Class B 8 A, or B 9 A, is superposed on this spectrum towards the end of shorter wave length.

198. A. G. C. 25108. The line Hδ appears wider and fully 1.5 as intense as Hγ or Hβ. This effect was noted on several plates, hence it is probably not due to defect in focus.

199. The line 4227.0 is 0.8 as intense as in α Phoenicis, the typical star, and Hγ is 0.7 as intense as 4326.0.

200. A. G. C. 20566. The faint spectrum of A. G. C. 20565, magnitude 7¾, which precedes $3^s.32$ and is north 2″.3, is superposed, and a narrow portion only appears on the preceding side. The spectrum of A. G. C. 20565 is of the second type, and probably similar to that of A. G. C. 20566.

201, A. G. C. 10769. This spectrum may be of Class K 5 M.

202. ε Carinæ. This spectrum is composite. The type is nearest to Class K, with the striking peculiarity of the almost entire absence of the wide line K, characteristic of that class. There is a decided haze covering the region but no distinct line or band. The hydrogen lines Hγ and Hβ are nearly as intense as in α Aurigæ, and Hδ is 2.0 as intense as Hγ or Hβ, on plates taken with one and two prisms. The hydrogen lines Hη and Hζ are seen as in stars of classes A or B. Hι and Hθ are also dimly seen on plates taken with one prism. 4227.0 is not more than 0.5 as intense as in Class K, and appears hazy. The bright bands 4470 to 4525, 4556 to 4586, and 4614 to 4648 are seen with nearly as great intensity as in α Tauri. On plates taken with one prism, the pair of lines composed of 4383.7 and 4385.2, seen as one, and 4405.0 and 4408.5, seen as one, are nearly as conspicuous as in α Tauri. Two anomalous lines between Hε and Hδ agree in position with the helium lines 4009.5 and 4026.4. The presence of these two lines causes this spectrum to look peculiar in this region. On plates taken with one prism, the effect of the presence of 4026.4 is that a band at wave length 4025, approximately, is much more intense than in typical spectra of classes G, K, or K 5 M. On X 8194, taken with two prisms, this band is resolved into lines, one of which corresponds exactly with 4026.4 in the Orion spectra. This line is fully as intense as the solar line 4024.8, and the well marked band visible on plates taken with one prism, appears to be formed by the superposition of these two lines. Likewise, a line not seen in spectra of Class K, corresponds to the helium line 4009.5, and a line of unusual intensity for spectra of Class K, corresponds to the helium line 4471.8. Other Orion lines could not be distinguished because they fall on solar lines or bands. It thus appears that this spectrum is composed of two spectra completely superposed, the brighter one being of Class K, or possibly K 5 M, while the fainter one is of the Orion type.

203. o^1 Canis Majoris. The line Hγ is as intense as in Class G 5 K, but Hβ is very faint, and the spectrum at the end of greater wave length is like that of Class K 2 M. The end of shorter wave length shows marked absorption, so that the spectrum is faint in the region having shorter wave length than 4227.0. The latter line is less intense than in the typical star, and is about equal to the same line in Class G 5 K.

204. δ^1 and δ^2 Apodis. These spectra are partly superposed.

205. The lines Hδ, Hγ, and Hβ are 2.0 as intense as in α Tauri, the typical star, and the edges of the absorption bands are less marked than in α Tauri.

206. The edges of the absorption bands at 4762 and 4954 are not so distinctly seen as in α Tauri, the typical star.

207. The edges of the absorption bands at 4762 and 4954 are more sharply defined than in α Tauri, the typical star, and are intermediate in intensity between those in α Tauri and γ Hydri.

208. t^2 Carinæ. The spectrum of A. G. C. 14561, magnitude 7¼, which follows $0^s.69$ and is south 4′ 45″.2, is superposed. The well marked hydrogen lines Hι, Hθ, Hη, Hζ, Hε, Hδ, Hγ, and Hβ of this spectrum are readily identified among the many lines in the spectrum of t^2 Carinæ.

209. A. G. C. 15986. No trace is seen of the spectrum of A. G. C. 15988, magnitude 8¼, which follows $3^s.70$ and is north 48″.3.

210. A. G. C. 12635. This spectrum may be of Class K.

211. α Orionis. This spectrum is slightly peculiar in the intensity of the lines of hydrogen, and of 4227.0. The lines of hydrogen are as intense as in the spectra of Class G 5 K, and Hγ, as in that class, is as intense as 4326.0. 4227.0 is less intense than in the typical star, γ Hydri, and is equal to 4227.0 in spectra of Class K. In the increased intensity of the hydrogen lines, and the diminished intensity of 4227.0, a composite type of spectrum is suggested. The edges of the absorption bands at 4762, 4954, and 5168 are intermediate in intensity between those in the spectra of γ Hydri and γ Crucis.

212. α Scorpii. The spectrum is of Class Ma, except that the hydrogen lines Hβ, Hγ, and Hδ are about 2.0 as intense as in γ Hydri, the typical star, the line K is hazy, and the hydrogen lines Hη and Hζ are present as in stars of the first type. The spectrum thus appears to be composite, and the fainter spectrum is probably of Class A, or between A and F.

213. β Gruis. This spectrum shows more intense bright bands and more marked changes in light than the typical star, γ Crucis. The bands 4556 to 4586, 4611 to 4626, and 4659 to 4668 are more intensely bright and have better defined edges than in γ Crucis. The edges of the absorption bands at 4762, 4954, and 5168 are strongly marked, and in the region of greater wave length than 4554, the dark lines are ill defined and appear like spaces between bright bands of varying width and intensity. 4315.2 is not more than 0.3 as intense as in the spectrum of γ Crucis, and is barely seen on plates taken with one prism.

214. This spectrum is similar to that of β Gruis.

215. L^2 Puppis. The spectrum resembles that of Class Mb, except that the hydrogen lines Hδ, Hγ, and Hβ, are bright. Hδ is nearly as intense as the bright Hβ in μ Centauri, and Hγ is about 0.9 as intense as Hδ. Hβ is faintly seen but appears to be bright. The region of Hε is not included in the photographs. The dark lines towards the end of greater wave length of this spectrum appear to be absent or broadened into dark spaces between bright bands. The lines that formed the band G are even less conspicuous than in Class Mb, and there is no change in the distribution of the light at this point.

216. R Carinæ. The spectrum is like that of L^2 Puppis

(See Remark 215), except that $H\beta$ is more distinctly bright in this spectrum. $H\delta$ is here 1.5 as intense as $H\gamma$, and $H\beta$ is about 0.2 as intense as $H\gamma$.

217. S Carinæ. $H\delta$, $H\gamma$, and $H\beta$ are bright. $H\gamma$ is slightly more intense than $H\delta$, and $H\beta$ is fainter. The dark line spectrum, which is of Class Mb, is faint.

218. ζ Phoenicis. No trace is seen of the spectrum of A. G. C. 1067, magnitude 8, which precedes $0^s.73$ and is south $2''.7$.

219. κ Tucanæ. The lines are ill defined on all the plates. This is probably due to the superposed spectrum of the companion star, A. G. C. 1212, magnitude 7, which follows $0^s.07$ and is north $6''.2$.

220. A. G. C. 10986. There is no trace of the spectrum of A. G. C. 10985, magnitude 7¾, which precedes $1^s.17$ and is north $32''.7$.

221. υ Carinæ. There is no trace of the spectrum of A. G. C. 13390, magnitude 7½, which follows $0^s.87$ and is south $3''.6$.

222. u Carinæ. No trace is seen of the spectrum of A. G. C. 14912, magnitude 7.6, which follows $1^s.85$ and is north $1'\,2''.3$.

223. h Centauri. No trace is seen of the spectrum of A. G. C. 18854, magnitude 8, which precedes $0^s.13$ and is south $14''.1$.

224. k Centauri. No trace is seen of the spectrum of A. G. C. 18834, magnitude 6¾, which follows $0^s.62$ and is south $3''.8$. The lines in k Centauri are slightly hazy.

225. A. G. C. 19406. No lines are seen belonging to the spectrum of A. G. C. 19407, magnitude 7¾, which follows $0^s.27$ and is south $10''.0$. The lines in the spectrum of A. G. C. 19406 are, however, very poorly defined, but it has not been determined whether this is due to the quality of the plates, or to the superposed spectrum.

226. μ Lupi. No trace is seen of the spectrum of A. G. C. 20714, magnitude 7, which follows $1^s.57$ and is south $16''.3$.

227. θ Indi. No trace is seen of the spectrum of A. G. C. 29213, magnitude 7½, which precedes $0^s.55$ and is north $1''.7$.

228. β Piscis Aust. No trace is seen of the spectrum of A. G. C. 30705, magnitude 7, which follows $0^s.37$ and is south $29''.7$.

229. A. G. C. 8227. The spectrum of A. G. C. 8225, magnitude 7¾, which precedes $0^s.91$ and is north $10''.3$, is not seen.

230. A. G. C. 14483. The spectrum of A. G. C. 14482, magnitude 8½, which precedes $1^s.20$ and is south $1'\,8''.4$, is superposed. On Plate X 9122, the lines $H\gamma$ and 4471.8 of the fainter spectrum are readily identified among the lines of A. G. C. 14483. The spectrum of A. G. C. 14482 is therefore, also, of the Orion type.

231. A. G. C. 25197. The spectrum of A. G. C. 25196, magnitude 8½, which precedes $0^s.14$ and is south $41''.4$, is not seen.

232. π Puppis. The spectrum of A. G. C. 9286, magnitude 8½, which precedes $3^s.02$ and is south $59''.8$, is not seen.

CHAPTER XIII.

GENERAL CATALOGUE.

A CATALOGUE of all the stars classified in Table XVI is given in Table XVII, in the order of right ascension. The explanation of the successive columns is given below, the heading in each case being prefixed. Exceptions are noted in the remarks following the Table.

No. A current number for reference.

M. P. The number of the star in the Southern Meridian Photometry, with the letter S prefixed, is given for all stars south of declination —30°, which occur in that work. For stars north of declination —30°, the number is taken from the Harvard Photometry and the letter H is prefixed. The stars S. M. P. 1858, 6370, 6908, and 7919, although north of —30°, are not contained in the Harvard Photometry. When a star is double according to the Southern Meridian Photometry or the Harvard Photometry, and the companion star does not appear in this catalogue, the number of the star is printed in Italics.

Constellation. For southern stars, the constellation is taken from the Argentine General Catalogue; for northern stars, from the Harvard Photometry. Since the designation by constellation given in the Harvard Photometry follows the notation of Heis, it will, in some cases, differ from that given here. These cases are specified in the remarks following Table XVII.

Des. For southern stars, the designation, like the constellation, is taken from the Argentine General Catalogue; for northern stars, from the Harvard Photometry.

A. G. C. The number of the star in the Argentine General Catalogue, when the star occurs in that work. Italics indicate that an adjacent star of magnitude 8¼ or brighter, is also contained in the Argentine General Catalogue.

R. A. 1900. The approximate right ascension of the star for 1900.

Dec. 1900. The approximate declination of the star for 1900.

Mag. The photometric magnitude of the star according to the catalogue given in the second column.

Class. The class of spectrum of each star taken from Table XVI.

Remarks. The numbers referring to the remarks following Table XVI.

No. Pl. The number of plates on which each spectrum has been examined.

Plate Numbers. The numbers designating the plates in the X series. The left hand figure, 1, is omitted when the number is 10,000, or greater. When more than three plates were examined, the additional plate numbers are given in Table XVIII.

Prs. The greatest number of prisms with which each star has been successfully photographed.

TABLE XVII

GENERAL CATALOGUE

No.	M. P.	Constellation.	Des.	A. G. C.	R. A. 1900.		Dec. 1900.		Mag.	Class.	Remarks.	No. Pl.	Plate Numbers.	Prs.
					h.	m.	°	′						
1	H 5	Andromeda	α	—	0	3.2	+28	33	2.08	A Pec.	141	1	7982	3
2	S 14	Phœnix	ε	57		4.4	−46	18	3.85	K	—	11	4444,4962,5209	2
3	S 38	Tucana	ζ	233		14.9	−65	29	4.28	F 8 G	—	9	4399,5166,5948	2
4	S 57	Hydrus	β	336		20.5	−77	49	2.89	G	—	10	4450,4451,5325	3
5	S 59	Phœnix	α	355		21.3	−42	51	2.45	K	—	19	4445,4497,5397	3
6	S 60	Phœnix	κ	351		21.3	−44	14	3.95	A 3 F	18	13	4487,4497,5907	2
7	S 64	Sculptor	η	377		22.9	−33	34	4.81	Mb	—	12	5056,5147,5176	1
8	H 68	Cetus	—	419		25.4	−24	21	5.23	A 3 F	—	9	5139,5290,5801	1
9	S 75	Phœnix	—	427		25.6	−48	46	5.47	F 5 G	—	4	5007,5265,5277	1
10	S 76	Phœnix	λ^1	443		26.6	−49	22	4.80	A 2 F	—	4	5007,5265,5277	1
11	S 78	Tucana	β^1	451		27.0	−63	31	4.50	B 9 A	117	9	4984,5158,5299	1
12	S 79	Tucana	β^2	452		27.0	−63	31	4.33	A 2 F	40,117	9	4984,5158,5299	1
13	S 84	Tucana	—	467		28.1	−63	35	5.07	A 2 F	—	4	6963,7085,7160	1
14	S 88	Tucana	θ	491		29.2	−71	49	5.99	A 5 F	68	2	4930,7319	1
15	S 91	Phœnix	λ^2	519		30.9	−48	33	5.45	F 8 G	—	4	5007,5265,5277	1
16	H 88	Cetus	—	544		32.1	−25	19	5.62	K	—	1	7308	1
17	H 95	Cetus	—	608		35.4	−24	21	6.15	K	—	1	7308	1
18	S 106	Phœnix	μ	626		36.6	−46	38	4.61	K	199	6	5023,5115,5167	1
19	S 109	Phœnix	ξ	633		37.2	−57	3	5.81	F Pec.	173	10	4951,6168,6936	2
20	S 118	Phœnix	η	662		38.8	−58	1	4.49	A	18	14	4951,5128,5841	2
21	S 142	Hydrus	λ	762		45.1	−75	28	4.95	K 5 M	—	10	9784,9794,9822	1
22	S 146	Phœnix	ρ	769		46.1	−51	32	5.00	F 5 G	—	7	9345,9743,9785	1
23	H 158	Sculptor	α	902		53.8	−29	54	4.06	B 5 A	—	8	4484,5252,5300	1
24	S 178	Phœnix	—	965		58.3	−46	56	5.18	K	—	4	4535,6903,0097	1
25	S 187	Phœnix	β	1024	1	1.6	−47	15	3.39	K	199	13	4333,4535,5398	2
26	S 196	Phœnix	ζ	*1069*		4.2	−55	47	4.07	B 8 A	218	4	4332,5185,5941	1
27	S 216	Phœnix	ν	1174		10.6	−46	4	4.92	G	—	6	9332,9744,9801	1
28	S 220	Tucana	κ	*1210*		12.3	−69	24	4.90	F 8 G	219	6	9327,9795,9843	1
29	S 257	Phœnix	γ	1411		24.0	−43	50	3.32	K 5 M	207	15	3900,5148,5168	2
30	H 236	Cetus	—	1421		24.8	−22	9	5.09	A	—	1	5342	1
31	S 262	Phœnix	δ	1462		27.0	−49	35	3.92	K	199	11	3896,5210,5301	2
32	S 290	Eridanus	α	1594		34.0	−57	44	0.51	B 5 A	18,85	20	3859,4498,5442	3
33	S 334	Phœnix	ψ	1864		49.6	−46	48	4.11	Mb	—	12	4931,5024,5202	1
34	S 337	Phœnix	φ	1871		50.2	−43	0	4.95	B 9 A	121	7	9346,9802,9823	1
35	H 302	Cetus	—	1895		52.0	−23	1	5.15	K 5 M	206	8	5159,5181,5186	1
36	S 343	Eridanus	χ	1905		52.0	−52	7	3.62	G 5 K	—	3	4473,5705,7248	1
37	S 345	Hydrus	η^2	1924		52.4	−68	9	4.65	K	199	3	4537,5008,5942	1
38	S 350	Eridanus	—	1932		53.1	−52	16	5.97	F 8 G	—	2	5705,7248	1
39	S 351	Phœnix	—	1931		53.2	−47	53	4.65	G 5 K	—	5	5024,5406,5419	1
40	H 313	Cetus	—	1962		55.1	−21	19	5.75	Ma	—	1	5270	1
41	H 315	Cetus	υ	1965		55.3	−21	34	3.83	Ma	—	11	4446,4536,5253	2
42	S 355	Phœnix	—	1973		55.5	−42	31	5.35	K	—	1	0108	1
43	S 356	Hydrus	α	1981		55.6	−62	4	2.96	F	18	13	4300,5853,7705	3
44	S 367	Fornax	π	1998		56.8	−30	29	5.19	G 5 K	—	4	6874,7123,7293	2
45	S 369	Phœnix	χ	2016		57.7	−45	12	4.91	K	68	4	9894,0063,0097	1
46	S 370	Fornax	—	2024		58.0	−30	9	6.43	A 3 F	—	3	6874,7123,7293	1
47	H 331	Fornax	ν	2065	2	0.0	−29	47	4.63	A Pec.	143	8	4952,5426,5842	2
48	H 333	Aries	α	—		1.5	+23	0	2.04	K 2 M	—	1	7955	3
49	S 438	Eridanus	φ	2339		12.9	−51	58	3.74	B 8 A	18	8	4334,5025,5706	2
50	S 461	Hydrus	δ	2498		19.9	−69	7	4.24	A 2 F	—	6	5009,5399,5943	2

No.	M. P.	Constellation.	Des.	A. G. C.	R. A. 1900.		Dec. 1900.		Mag.	Class.	Remarks.	No. Pl.	Plate Numbers.	Prs.
					h.	m.	°	′						
51	S 473	Eridanus	κ	2556	2	23.3	−48	9	4.28	B 5 A	84	6	4475,5211,5291	1
52	S 475	Fornax	φ	2565		23.8	−34	15	5.16	A 2 F	—	6	5116,5843,6156	1
53	H 404	Fornax	ω	*2693*		29.5	−28	40	4.78	B 9 A	116	6	5140,5326,5835	1
54	S 497	Hydrus	μ	2824		33.8	−79	33	5.27	K	—	1	7273	1
55	S 509	Eridanus	s	2838		36.0	−43	20	4.72	A	18	19	5057,5296,5310	2
56	—	Hydrus	—	2853		36.2	−67	44	R	K	—	2	5446,6966	1
57	S 516	Eridanus	ι	2851		36.7	−40	17	3.92	K	—	8	4447,4489,4490	1
58	S 523	Hydrus	ε	2887		38.1	−68	42	4.17	B 9 A	—	5	4301,5292,5951	1
59	S 534	Fornax	—	2919		40.1	−32	57	6.09	A	132	2	5169,7086	1
60	S 539	Horologium	—	2965		41.7	−67	8	6.19	F 8 G	—	3	5466,6966,7145	1
61	S 548	Hydrus	ζ	3003		44.0	−68	3	4.79	A 2 F	—	10	5160,5446,6137	1
62	S 550	Fornax	β	3009		44.9	−32	50	4.16	K	—	5	5149,5169,6147	1
63	H 453	Eridanus	τ^{2}	3034		46.5	−21	25	4.83	K	199	4	5182,5262,5707	1
64	—	Hydrus	—	3116		49.5	−67	56	R	K	—	2	5446,6966	1
65	S 575	Hydrus	ν	3171		51.1	−75	29	4.66	K 2 M	—	7	5303,5498,5499	1
66	S *584*	Eridanus	θ	*3223*		54.5	−40	42	R	A 2 F	148	16	4380,5117,6130	2
67	S 591	Horologium	β	3279		56.9	−64	28	4.98	A 5 F	—	8	5263,5319,5952	1
68	H 482	Cetus	α	—		57.1	+ 3	42	2.68	Ma	—	1	7944	3
69	H 487	Eridanus	τ^{3}	3284		58.0	−24	1	4.10	A 3 F	—	7	4485,5266,6166	2
70	H 512	Fornax	α	3462	3	7.9	−29	23	3.77	F 8 G	—	10	4433,4508,5334	2
71	H 530	Eridanus	—	3588		13.9	−22	52	5.02	K	—	2	7257,8029	2
72	H 533	Eridanus	τ^{4}	3607		15.1	−22	7	3.79	Mb	—	9	5271,7257,7807	2
73	S 657	Eridanus	e	3623		15.9	−43	27	4.27	G 5 K	—	3	5170,6138,7192	1
74	H 541	Perseus	α	—		17.1	+49	30	1.94	F 5 G	178	1	7983	3
75	S 696	Reticulum	κ	3879		27.6	−63	18	4.80	F 5 G	—	6	5187,5344,5927	1
76	H 579	Eridanus	τ^{5}	3897		29.4	−21	58	4.21	B 8 A	—	5	4335,5141,5854	1
77	S 722	Eridanus	y	4006		33.5	−40	36	4.48	K	199	4	5254,5959,6213	1
78	S 734	Fornax	δ	4101		38.3	−32	15	4.92	B 5 A	—	5	5203,5359,5420	1
79	H 608	Taurus	—	—		39.0	+23	48	3.82	B 5 A	86	7	7956,8123,8124	2
80	S 738	Eridanus	h	4121		39.1	−37	38	4.42	K 2 M	—	4	5150,5293,6149	1
81	H 610	Taurus	q	—		39.3	+24	10	4.44	B 5 A	86	7	7956,8123,8124	2
82	H 613	Taurus	—	—		39.9	+24	4	3.98	B 5 A	86	7	7956,8123,8124	2
83	H 615	Taurus	—	—		40.4	+23	39	4.22	B 5 A	86	7	7956,8123,8124	2
84	H 618	Taurus	η	—		41.6	+23	48	3.00	B 5 A	86	7	7956,8123,8124	2
85	H 623	Eridanus	τ^{6}	4191		42.6	−23	32	4.30	F 8 G	183	8	4378,4538,4539	2
86	S 755	Reticulum	β	4211		42.9	−65	7	3.76	K	—	5	4430,5320,6158	2
87	H 625	Taurus	—	—		43.3	+23	45	3.77	B 8 A	105	7	7956,8123,8124	2
88	R	Taurus	—	—		43.3	+23	51	R	*B 8 A*	105	2	8127,8179	2
89	H 627	Eridanus	τ^{7}	4208		43.4	−24	11	4.82	A 2 F	—	5	4538,4539,5335	2
90	—	Eridanus	—	4225		44.0	−36	24	R	B 8 A	111	2	5400,6139	1
91	S 764	Eridanus	f	4241		44.9	−37	55	4.52	A	108	6	4414,5294,5304	1
92	S 765	Eridanus		4242		44.9	−37	55		B 8 A	108	6	4414,5294,5304	1
93	S 766	Eridanus	g	4256		45.7	−36	30	4.12	K	—	7	5400,5427,6139	2
94	—	Eridanus	—	4286		46.9	−36	43	R	B 9 A	122	2	5400,6139	1
95	S 779	Hydrus	γ	4353		48.8	−74	33	3.12	Ma	—	8	4336,6262,5485	3
96	H 646	Eridanus	τ^{8}	4336		49.5	−24	55	4.70	B 5 A	—	3	5183,6167,7203	1
97	H 660	Eridanus	τ^{9}	4447		55.7	−24	18	4.62	A Pec.	144	2	5142,5976,	1
98	S 809	Reticulum	δ	4487		57.2	−61	41	4.31	Ma	—	14	5161,5297,5312	1
99	S 821	Reticulum	γ	4545		59.5	−62	27	4.41	Mb	—	11	5297,5312,5131	1
100	S 823	Reticulum	ι	4550		59.7	−61	22	4.79	K 5 M	—	14	5161,5297,5312	1

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101	S 850	Horologium	δ	4686	4	7.4	−42	15	4.78	F	—	8	4474,5409,5977	2
102	S 858	Horologium	α	4757		10.7	−42	32	3.79	K	—	10	4474,5409,5977	2
103	S 868	Reticulum	α	4812		13.1	−62	43	3.35	G 5 K	—	7	4434,4499,5855	2
104	S 869	Dorado	γ	4811		13.4	−51	44	4.31	F 5 G	—	5	5171,5496,6132	1
105	S 872	Eridanus	X	4821		14.1	−34	2	3.76	B 9 A	114	7	4466,4476,5401	2
106	S 874	Reticulum	ε	4840		14.7	−59	32	4.39	K 2 M	—	3	5336,5917,6272	1
107	S 894	Eridanus	d	4940		20.2	−34	14	3.94	K 5 M	205	7	5373,5953,6214	2
108	—	Cælum	—	4974		22.2	−44	23	R	F 8 G	—	2	7221,7251	1
109	S 925	Cælum	δ	5106		27.8	−45	10	5.28	B 3 A	—	7	5321,5421,5961	1
110	H 796	Eridanus	ν^1	5137		29.6	−29	58	4.43	K	—	9	4477,5328,5360	2
111	H 797	Taurus	α	—		30.2	+16	19	1.00	K 5 M	—	11	3864,3868,3870	3
112	S 942	Eridanus	ν^2	5187		31.7	−30	46	3.78	K	199	9	4477,5328,5360	2
113	S 943	Dorado	α	5198		31.8	−55	15	3.53	A Pec.	145	5	4381,5856,7324	2
114	—	Cælum	—	5244		34.1	−42	5	R	A 5 F	—	1	6150	1
115	S 964	Cælum	α	5295		37.3	−42	3	4.55	F 2 G	—	4	5337,5410,6150	1
116	S 972	Cælum	β	5313		38.5	−37	20	5.16	F 5 G	—	6	5352,5447,5970	1
117	—	Cælum	—	5351		40.4	−41	15	R	K 5 M	—	2	5337,6150	1
118	H 845	Orion	π^4	—		45.9	+ 5	26	3.98	B 3 A	—	1	4531	1
119	S 1057	Pictor	η^1	5798	5	0.2	−49	18	5.44	F 5 G	—	6	0060,0078,0087	1
120	S 1060	Cælum	γ	5807		0.8	−35	37	4.59	K	171	6	5361,5402,6159	1
121	—	Cælum	—	5810		0.9	−35	51	R	F	171	4	5402,6159,7166	1
122	H 901	Lepus	ε	5816		1.3	−22	30	3.26	K 5 M	—	4	4478,5151,6195	2
123	S 1066	Pictor	η^2	5850		2.3	−49	43	4.91	K 5 M	—	6	0060,0078,0087	1
124	S 1071	Dorado	ζ	5893		3.8	−57	37	4.70	F 8 G	—	3	5205,6170,7204	1
125	H 932	Auriga	α	—		9.3	+45	54	0.18	G	—	9	3886,3887,4534	3
126	H 936	Orion	β	6004		9.7	− 8	19	0.32	B 8 A Pec.	40,112	9	3879,4084,4101	3
127	S 1114	Columba	—	6062		12.2	−35	2	6.80	A 2 F	133	4	5466,6171,7167	1
128	S 1116	Columba	ο	6098		13.9	−34	59	4.96	K	—	6	5322,5466,6171	1
129	S 1117	Dorado	θ	6119		13.9	−67	18	4.75	K	—	3	5313,6178,7187	1
130	H 963	Lepus	—	6141		16.2	−21	20	4.63	A	127	4	5458,5486,6204	1
131	S 1124	Columba	—	6158		16.7	−34	48	6.50	F	—	4	5466,6171,7167	1
132	—	Columba	—	6182		17.7	−34	26	R	B 5 A	93	5	5466,6171,6240	1
133	H 979	Orion	γ	—		19.7	+ 6	16	1.86	B 2 A	—	1	7978	3
134	H 994	Lepus	β	6344		24.0	−20	51	3.03	G	—	7	4479,6151,7325	2
135	H 997	Orion	—	6359		24.7	− 1	11	4.90	Ma	—	1	3856	1
136	H 1005	Orion	δ	6401		26.9	− 0	23	2.36	B	18,19	6	3856,3873,3874	3
137	H 1006	Lepus	—	6404		26.9	−20	56	5.36	A	—	1	6151	1
138	S 1176	Columba	ε	6427		27.7	−35	33	3.86	K	—	8	4415,6187,7243	2
139	—	Orion	—	6458		29.4	− 4	52	R	A 2 F	133	1	3881	1
140	S 1187	Columba	—	6466		29.6	−35	13	5.60	K	—	1	4415	1
141	H 1021	Orion	—	6469		30.1	− 6	5	4.47	B 1 A	38	1	3881	1
142		Orion	—	6471		30.1	− 6	4		B 1 A	38	1	3881	1
143	H 1023	Orion	θ^1	6478		30.3	− 5	27	4.41	Oe 5 B	16	1	3881	1
144	—	Orion	—	6481		30.4	− 4	34	R	B	25	1	3881	1
145	—	Orion	—	6482		30.4	− 4	29	R	B	25	1	3881	1
146	H 1025	Orion	c	6483		30.4	− 4	54	4.60	B 3 A	68	1	3881	1
147	H 1024	Orion	θ^2	6484		30.4	− 5	29	4.90	B 1 A	37	1	3881	1
148	—	Orion	—	6487		30.5	− 4	26	R	B 5 A	68	1	3881	1
149	R	Orion	—	—		30.5	− 5	29	R	B 1 A	37	1	3881	1
150	H 1027	Orion	ι	6486		30.5	− 5	59	2.97	Oe 5 B	15	1	4069	1

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151	H 1026	Orion	—	6493	5	30.7	− 4	55	4.95	F	—	1	3881	1
152	H 1029	Orion	ε	6501		31.2	− 1	16	1.76	B	—	4	3851,4041,7979	3
153	—	Orion	—	6503		31.3	− 5	43	R	B 3 A	68	1	3881	1
154	—	Orion	—	6512		31.7	− 6	8	R	B 3 A	68	1	3881	1
155	—	Orion	—	6533		32.5	− 6	0	R	B 1 A	36	1	3881	1
156	—	Orion	—	6535		32.7	− 5	0	R	B 3 A	68	1	3881	1
157	S 1199	Dorado	β	6561		32.7	−62	33	3.70	F 5 G	179	6	4431,4500,5497	2
158	—	Orion	—	6542		32.9	− 4	52	R	B 1 A	—	1	3881	1
159	H *1045*	Orion	ζ	6614		35.8	− 2	0	R	B	18,19	1	8115	3
160	H 1047	Orion	—	6616		35.8	− 1	11	5.06	B 3 A	—	1	3851	1
161	S 1214	Mensa	γ	6674		35.8	−76	25	4.97	K	68	6	0066,0079,0113	1
162	S 1217	Columba	α	6633		36.0	−34	8	2.74	*B 5 A*	18,97	13	4480,5919,6263	2
163	H 1057	Lepus	γ	6733		40.4	−22	28	3.76	F 8 G	—	2	4481,8197	2
164	S 1264	Dorado	δ	6852		44.6	−65	46	4.49	A 5 F	—	3	5403,5989,7213	1
165	S 1268	Pictor	β	6848		44.9	−51	6	3.92	A 3 F	18	32	4467,4468,6201	2
166	H 1086	Lepus	δ	6884		47.0	−20	54	3.98	K	—	4	4509,7235,7320	2
167	S 1284	Columba	β	6896		47.5	−35	49	3.06	K	—	10	4432,5429,6160	2
168	S 1288	Pictor	γ	6915		48.0	−56	12	4.29	K	—	4	5278,6179,7185	1
169	S 1293	Pictor	—	6925		48.7	−52	8	4.75	K	—	5	0074,0092,0101	1
170	S 1294	Columba	—	6931		49.2	−37	40	5.59	K	—	1	0080	1
171	S 1295	Columba	λ	6937		49.5	−33	50	5.00	B 5 A	—	4	5305,6202,6252	1
172	H 1091	Orion	α	—		49.8	+ 7	23	0.91	Ma	211	6	3875,3883,4533	3
173	S 1297	Dorado	ε	6972		50.0	−66	56	4.98	B 5 A	—	4	5329,6180,6273	1
174	S 1310	Columba	ξ	7011		52.1	−37	8	4.93	K	—	1	0080	1
175	H 1100	Auriga	β	—		52.2	+44	57	2.07	A Pec.	142	4	7973,8135,8146	3
176	S 1315	Pictor	—	7034		52.7	−52	40	5.25	A 5 F	165	1	0074	1
177	S 1319	Dorado	—	7066		53.4	−63	8	4.41	K	—	4	5362,6188,7189	1
178	S 1322	Columba	γ	7064		54.0	−35	18	4.49	B 3 A	—	5	4432,5314,5429	1
179	S 1329	Columba	η	7120		56.1	−42	49	4.00	K	—	5	4510,6142,7244	2
180	—	Columba	—	7164		57.8	−42	52	R	B 8 A	—	2	4510,7244	1
181	S 1366	Columba	—	7274	6	1.9	−35	30	6.10	A 2 F	133	1	6133	1
182	S 1374	Columba	—	7321		3.5	−34	18	6.16	B 5 A	57	1	6133	1
183	S 1388	Pictor	—	7410		6.1	−62	8	4.97	K	—	2	0067,0137	1
184	S 1400	Pictor	δ	7467		8.4	−54	56	4.84	B 1 A	18	5	5430,6134,6254	1
185	S 1404	Dorado	ν	7513		9.3	−68	49	5.21	B 9 A	—	6	5422,5479,6143	1
186	S 1416	Dorado	η^2	7557		11.1	−65	34	4.81	Mb	—	1	0088	1
187	S 1429	Columba	κ	7586		13.0	−35	6	4.50	K	—	4	5338,6152,7194	1
188	—	Columba	—	7672		16.1	−34	22	R	B 8 A	—	3	5338,6152,7194	1
189	S 1444	Canis Major	ζ	7681		16.5	−30	2	3.25	B 3 A	—	3	4491,6161,8203	2
190	S 1445	Columba	—	7697		17.0	−34	6	5.57	B 2 A	—	4	5448,6152,6162	1
191	S 1453	Columba	δ	7731		18.4	−33	23	3.84	G 5 K	—	4	5448,6162,8257	2
192	S 1471	Dorado	—	7817		20.2	−69	45	6.94	F 8 G	132	1	7311	1
193	S 1480	Carina	α	7843		21.8	−52	39	−0.96	F	—	24	3841,3849,3850	3
194	S 1499	Canis Minor	λ	7904		24.4	−32	31	4.60	B 5 A	—	5	4416,5279,6205	1
195	S 1503	Canis Major	—	7914		24.9	−32	18	6.00	B 3 A	—	4	5279,6205,7237	1
196	H 1235	Canis Major	ξ^1	7989		27.6	−23	21	4.21	B 1 A	—	4	4598,5505,6215	1
197	S 1528	Canis Major	—	*8017*		28.9	−31	57	5.93	B 3 A	—	4	5279,6205,7237	1
198	S 1530	Carina	—	8034		29.0	−51	45	5.68	F 8 G	—	2	5460,0124	1
199	H 1242	Canis Major	ξ^2	8065		30.8	−22	53	4.35	A	—	4	4598,5505,6215	1
200	—	Canis Major	—	8109		32.5	−22	32	R	B 8 A	68	1	7214	1

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201	S 1553	Carina	N	8133	6 32.8	−52 53	4.46	A	126	2	5460,7186	1
202	—	Canis Major	—	8161	34.2	−23 29	R	F 8 G	—	1	7214	1
203	S 1569	Puppis	ν	8181	34.7	−43 6	3.23	B 8 A	18,104	5	4492,5487,6153	2
204	S 1583	Puppis	—	*8227*	36.0	−48 8	4.99	K	229	2	9380,0104	1
205	H 1275	Canis Major	α	8348	40.7	−16 34	−1.43	A	—	16	3862,3869,3968	3
206	—	Canis Major	—	8495	45.5	−24 2	R	A	133	1	4512	1
207	H 1294	Canis Major	—	8500	45.5	−23 58	6.15	A	—	1	4512	1
208	S 1643	Canis Major	κ	8518	46.1	−32 24	3.90	*B 2 A*	18,48	6	4469,6209,6224	2
209	—	Canis Major	—	8520	46.6	−20 48	R	B 3 A	29	1	7175	1
210	S 1649	Puppis	—	8551	47.2	−34 15	4.93	K	—	2	0105,0130	1
211	S 1650	Pictor	α	8570	47.2	−61 50	3.29	A 5 F	—	4	4517,6197,8310	2
212	S 1653	Puppis	τ	8568	47.4	−50 30	2.76	K	—	5	4493,4540,5962	2
213	S 1654	Carina	A	8573	47.6	−53 31	4.35	G 5 K	196	5	5363,5436,6198	1
214	H 1306	Canis Major	—	8592	49.0	−18 55	5.50	F	150	2	5330,7175	1
215	—	Canis Major	—	8594	49.0	−18 49	R	A 2 F	150	2	5330,7175	1
216	H 1308	Canis Major	—	8602	49.2	−20 6	4.43	B 1 A	—	2	5330,7175	1
217	—	Canis Major	—	8607	49.2	−24 34	R	A 2 F	—	1	4512	1
218	—	Canis Major	—	8624	49.8	−24 25	R	A	—	1	4512	1
219	H 1312	Canis Major	o^1	8629	49.9	−24 4	4.04	K 2 M	203	5	4108,4115,4512	2
220	H 1311	Canis Major	—	8631	50.0	−23 48	6.37	Ob	7	5	4108,4115,4512	2
221	H 1314	Canis Major	—	8646	50.7	−20 17	5.88	A 2 F	—	2	5330,7175	1
222	H 1315	Canis Major	π	8658	51.3	−20 1	4.45	F 5 G	—	2	5330,7175	1
223	H 1317	Canis Major	—	8671	51.6	−22 49	5.19	B 3 A	—	2	4108,4115	1
224	H 1320	Canis Major	—	8724	53.4	−24 30	5.19	F 5 G	—	3	4108,4115,4512	1
225	S 1685	Puppis	—	8739	53.6	−48 35	4.91	Ma	—	2	0081,0117	1
226	—	Canis Major	—	8742	54.1	−27 2	R	B 3 A	68	1	6233	1
227	H 1325	Canis Major	ε	8752	54.7	−28 50	1.49	B 1 A	39,40	5	4102,8396,8940	2
228	—	Canis Major	—	8808	56.8	−28 21	R	F 8 G	—	2	4513,6233	1
229	S *1708*	Canis Major	—	8815	57.0	−25 4	R	B 3 A	—	1	4511	1
230	H 1333	Canis Major	σ	8839	57.7	−27 47	3.49	K 5 M	—	3	4513,6233,8204	2
231	H 1337	Canis Major	o^2	8873	58.8	−23 41	3.05	B 5 A Pec.	40,96	6	4511,6225,6232	2
232	—	Canis Major	—	8991	7 3.2	−23 41	R	*B 3 A*	82	3	6225,6232,6255	1
233	H 1350	Canis Major	δ	9021	4.3	−26 14	1.85	F 8 G Pec.	40,185	4	6275,8274,8948	2
234	—	Canis Major	—	9031	4.6	−23 53	R	B 3 A	68	1	6232	1
235	S 1775	Puppis	A	9060	5.5	−39 29	4.87	B 3 A	58	1	0094	1
236	—	Canis Major	—	9123	8.1	−25 46	R	B 3 A	—	2	6432,6455	1
237	—	Canis Major	—	9121	8.1	−27 10	R	B 3 A	—	1	6455	1
238	S 1793	Puppis	—	9135	8.1	−48 46	5.08	K 2 M	—	2	6189,7205	1
239	—	Canis Major	—	9131	8.4	−27 18	R	A 2 F	133	1	6455	1
240	—	Canis Major	—	9165	9.6	−22 44	R	B 3 A	—	1	5353	1
241	—	Canis Major	—	9168	9.6	−27 11	R	B 3 A	—	1	6455	1
242	S 1803	Volans	γ^1	9199	9.6	−70 20	3.62	G	191	2	5467,6216	1
243	S 1804	Volans	γ^2	9206	9.6	−70 20		K	191	2	5467,6216	1
244	S 1805	Puppis	I	9176	9.7	−46 35	4.54	F	—	5	5323,5449,6203	1
245	H 1368	Canis Major	—	9181	10.2	−26 10	4.54	*B 5 A* Pec.	101	10	4417,4518,6210	2
246	S 1813	Puppis	L^1	9194	10.2	−45 0	5.08	A Pec.	146	2	8983,8989	2
247	S 1815	Puppis	L^2	9197	10.5	−44 29	var.	Md	215	2	8983,8989	2
248	H 1370	Canis Major	ω	9198	10.7	−26 35	3.69	*B 3 A*	76	12	4417,4518,6210	2
249	—	Canis Major	—	9205	10.8	−26 51	R	K 5 M	—	2	6432,6455	1
250	—	Canis Major	—	9226	11.5	−23 33	R	A	133	1	5353	1

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251	S 1825	Puppis	—	9243	7 11.9	−46 41	5.84	A	134	3	6203,7224,7391	1
252	S 1826	Puppis	—	9244	11.9	−48 6	4.88	B 8 A	—	5	5339,6189,7205	1
253	H 1374	Canis Major	—	9247	12.4	−23 9	4.67	K 5 M	169	1	5353	1
254	—	Canis Major	—	9250	12.5	−23 9	R	F	169	1	5353	1
255	H 1375	Canis Major	—	9255	12.6	−27 43	4.92	Mb	—	1	4417	1
256	S 1840	Puppis	—	9276	13.3	−36 25	5.20	B 3 A	—	12	4507,5480,6226	2
257	S 1842	Puppis	—	9283	13.4	−46 36	5.61	K 5 M	132	1	7224	1
258	S 1845	Puppis	π	*9288*	13.6	−36 55	2.49	K 5 M	205,232	17	4507,5480,6226	2
259	—	Canis Major	—	9287	13.7	−26 37	R	B 5 A	—	2	4417,6455	1
260	H 1380	Canis Major	—	9311	14.5	−24 23	4.77	Oe	—	3	5315,6265,7231	1
261	H 1381	Canis Major	τ	9313	14.5	−24 47	4.31	Oe 5 B	—	3	5315,6265,7231	1
262	H 1383	Canis Major	—	9323	14.8	−26 25	5.36	G	—	2	4417,6455	1
263	S 1856	Puppis	v^1	9326	14.8	−36 33	4.80	*B 3 A*	18,77	15	4507,5480,6226	2
264	S 1858	Canis Major	—	9334	15.0	−24 47	7.30	B 3 A	64	1	7231	1
265	S 1860	Puppis	v^2	9338	15.1	−36 34	5.33	B 3 A	—	13	4507,5480,6226	2
266	—	Canis Major	—	9364	16.5	−26 31	R	F	—	1	6455	1
267	—	Canis Major	—	9374	16.8	−26 47	R	B 3 A	—	1	4417	1
268	S 1874	Volans	δ	9407	16.9	−67 47	3.92	F 5 G	181	5	4514,6221,7245	2
269	H 1399	Canis Major	η	9476	20.2	−29 7	2.41	B 5 A Pec.	40,96	5	4470,7206,8346	2
270	—	Puppis	—	9589	24.0	−28 57	R	B 9 A	123	1	7206	1
271	S 1939	Puppis	—	9621	25.3	−31 15	6.10	B 3 A	68	1	6164	1
272	H 1416	Puppis	—	9632	25.6	−22 49	4.83	A 3 F	—	1	0138	1
273	S 1951	Puppis	σ	9652	26.1	−43 6	2.99	K 5 M	—	6	4519,6244,5488	2
274	S 1953	Puppis	—	9664	26.9	−30 45	4.72	G	—	1	6164	1
275	S 1961	Carina	—	9697	27.6	−52 26	5.94	G 5 K	—	1	9091	1
276	H *1423*	Gemini	α	—	28.2	+32 7	R	A	18,129	2	8116,8120	3
277	H 1431	Puppis	—	9733	29.8	−22 5	4.51	F 8 G	—	3	5423,6206,0138	1
278	—	Puppis	—	9752	30.3	−25 54	R	A	133	1	5450	1
279	—	Puppis	—	9755	30.5	−26 48	R	K	—	1	5450	1
280	—	Puppis	—	9787	31.4	−26 24	R	A 2 F	133	1	5450	1
281	S 1996	Carina	Q	9845	33.2	−52 18	4.91	K 5 M	—	3	9091,9414,0075	1
282	S 1997	Puppis	f	9850	33.6	−34 44	4.67	B 8 A	—	2	5306,7225	1
283	H 1442	Canis Minor	α	—	34.1	+ 5 30	0.46	F 5 G	—	7	3876,3882,4026	3
284	H 1445	Puppis	k	9880	34.7	−26 34	3.86	B 8 A	62	2	5450,6211	1
285	H 1446	Puppis	—	9881	34.7	−26 34		B 3 A	62	2	5450,6211	1
286	—	Puppis	—	9900	35.3	−26 38	R	B 8 A	69	1	5450	1
287	—	Puppis	—	9902	35.4	−26 41	R	B 3 A	69	1	5450	1
288	S 2025	Puppis	d^3	9935	36.3	−38 1	5.97	B 5 A	—	1	4506	1
289	—	Puppis	—	9940	36.4	−37 20	R	B 3 A	68	1	6234	1
290	S 2036	Puppis	—	9978	37.8	−38 18	5.67	B 8 A	—	1	4506	1
291	H 1458	Puppis	—	10001	38.6	−26 7	5.84	K	—	1	5450	1
292	H 1459	Gemini	β	—	39.2	+28 16	1.12	K	—	2	4025,8117	3
293	H 1461	Puppis	—	10025	39.5	−28 11	5.04	K 5 M	—	2	4379,6181	1
294	H 1462	Puppis	l	10033	39.8	−28 43	4.15	A 2 F Pec.	40,155	2	4379,6181	1
295	—	Puppis	—	10053	40.2	−37 58	R	B 5 A	68	1	5489	1
296	H 1464	Puppis	—	10055	40.4	−24 26	5.39	B 3 A	—	3	4505,7238,8259	2
297	—	Puppis	—	10088	41.0	−37 43	R	B 8 A	—	2	5489,6234	1
298	—	Puppis	—	10109	41.5	−37 39	R	B 3 A	—	3	4506,5489,6234	1
299	S 2075	Puppis	c	10113	41.7	−37 44	3.40	K 5 M	—	5	4506,5489,6234	2
300	S 2076	Puppis	—	10120	41.8	−34 0	5.40	F 8 G	—	1	6172	1

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301	—	Puppis	—	10145	7 42.6	−37 42	R	B 3 A	68	1	5489	1
302	S 2082	Volans	ζ	10203	43.0	−72 22	3.82	K	—	2	5404,7392	1
303	H 1472	Puppis	o	10182	43.9	−25 42	4.68	*B 2 A*	18,49	5	5388,8259,8275	2
304	S 2090	Puppis	—	10188	43.9	−38 16	5.30	B 3 A	—	5	4504,4506,5489	1
305	S 2094	Puppis	—	10211	44.5	−46 22	5.28	B 2 A	—	3	5324,6173,7230	1
306	—	Puppis	—	10215	44.9	−24 40	R	G	—	5	4505,5388,7238	2
307	H 1474	Puppis	ξ	10225	45.1	−24 37	3.40	G	189	6	4505,7238,8259	2
308	S 2102	Puppis	Q	10249	45.3	−46 50	4.68	K	—	5	5324,5431,6144	1
309	S 2108	Puppis	P	10268	46.2	−46 8	4.11	B	—	4	5324,5431,6173	1
310	S 2110	Puppis	—	10269	46.3	−46 37	5.98	B 2 A	—	3	5324,6173,7230	1
311	S 2120	Puppis	—	10316	47.7	−50 15	5.85	K 5 M	132	1	6444	1
312	—	Puppis	—	10331	48.2	−46 58	R	B 3 A	—	4	5468,6144,6173	1
313	S 2129	Puppis	a	10343	48.8	−40 19	3.72	G 5 K	—	1	6256	1
314	S 2134	Puppis	b	10350	49.1	−38 36	4.67	B 3 A	—	4	4504,5389,6276	1
315	S 2139	Puppis	—	10387	50.1	−50 16	7.24	B 3 A	29	1	6444	1
316	S 2142	Puppis	—	10390	50.2	−49 21	4.81	B 3 A	50	32	6320,6337,6355	2
317	S 2143	Puppis	J	10392	50.3	−47 51	4.28	B 1 A	18,34	8	5468,6144,6235	1
318	S 2155	Puppis	—	10430	51.6	−49 55	7.59	B 3 A	29	1	6444	1
319	H 1492	Puppis	j	10450	52.6	−22 37	4.26	F 8 G	—	2	5331,7329	1
320	S 2171	Puppis	—	10482	53.7	−30 4	4.91	A 2 F	—	4	9084,9368,0082	1
321	S 2178	Carina	χ	10507	54.2	−52 43	3.56	B 3 A	—	3	4501,6243,8347	2
322	—	Puppis	—	10510	54.3	−47 37	R	B 5 A	—	2	5468,6144	1
323	H 1500	Puppis	—	10512	54.8	−23 2	5.22	G 5 K	—	2	5331,7329	1
324	S 2190	Puppis	—	10534	55.3	−48 58	4.50	B 1 A Pec.	41	61	5437,6182,6315	2
325	—	Carina	—	10565	55.9	−63 2	R	B 8 A	68	1	6174	1
326	S 2201	Puppis	—	10546	56.0	−39 1	5.20	F	132	1	5354	1
327	—	Puppis	—	10558	56.0	−48 6	R	B 3 A	—	7	6182,6320,6337	1
328	S 2206	Puppis	—	10566	56.4	−49 42	5.98	B 3 A	65	15	6182,6315,6320	1
329	S 2207	Puppis	—	10568	56.4	−49 42		B 3 A	65	15	6182,6315,6320	1
330	—	Carina	—	10613	57.2	−60 33	R	B 3 A	—	1	0093	1
331	—	Puppis	—	10605	57.3	−48 42	R	A 2 F	—	14	5437,6182,6315	1
332	—	Puppis	—	10618	57.5	−48 36	R	A	137	14	5437,6182,6315	1
333	S 2223	Carina	—	10639	57.9	−59 56	6.52	B 8 A	111	1	0093	1
334	S 2224	Carina	—	10641	57.9	−60 19	5.06	Ma	—	1	0093	1
335	—	Puppis	—	10646	58.5	−49 20	R	B 3 A	—	8	6320,6329,6355	1
336	S 2235	Carina	D	10678	59.1	−63 17	4.97	B 3 A	—	3	5462,6174,7407	1
337	—	Puppis	—	10689	59.8	−49 40	R	F	—	3	6320,6413,6507	1
338	—	Puppis	—	10693	59.9	−48 2	R	B 3 A	—	2	6182,6345	1
339	S 2248	Puppis	ζ	10691	8 0.1	−39 43	2.33	Od	11	18	3960,4032,4033	2
340	—	Puppis	—	10705	0.6	−49 13	R	K	—	4	6320,6413,6421	1
341	H 1515	Puppis	ρ	10763	3.3	−24 1	2.88	F 5 G	—	5	3974,3980,6165	2
342	S 2276	Carina	—	10779	3.3	−62 33	6.40	B 3 A	—	1	6174	1
343	S 2277	Vela	—	10769	3.5	−44 58	4.82	K	201	4	9092,9423,0068	1
344	—	Vela	—	10781	3.7	−48 12	R	B 3 A	—	1	9418	1
345	S 2300	Vela	—	10856	6.3	−43 49	5.21	B 3 A	—	2	0068,0118	1
346	S 2303	Vela	—	10861	6.4	−47 3	4.91	B 3 A	63	6	3961,4070,6266	2
347	S 2305	Vela	γ	10868	6.5	−47 2	1.91	Oa Pec.	5	11	3961,4060,4070	2
348	S 2309	Vela	—	10873	6.7	−47 38	5.38	B 3 A	—	5	4070,6266,8514	2
349	—	Carina	—	10897	7.1	−63 30	R	B 8 A	111	1	6174	1
350	S 2313	Carina	B	10904	7.3	−60 59	4.82	F 5 G	—	3	9389,9422,0093	1

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351	S 2314	Volans	ε	*10923*	8 7.6	−68 19	4.45	B 5 A	88,89	2	5395,6244	1
352	S 2318	Puppis	h^1	10901	7.8	−39 19	4.27	K 5 M	205	4	5364,6190,7246	1
353	S 2321	Puppis	—	10913	8.0	−42 41	4.85	A 3 F	—	3	9374,9405,0100	1
354	—	Vela	—	10920	8.2	−48 9	R	B 3 A	—	1	9418	1
355	—	Vela	—	10953	9.3	−45 57	R	B 3 A	—	1	0089	1
356	S 2336	Puppis	r	10963	9.7	−35 35	5.00	*B 3 A*	78	1	5340	1
357	S 2344	Puppis	—	*10973*	10.2	−36 1	5.27	B 3 A	66	1	5340	1
358	S 2350	Puppis	h^2	10984	10.5	−40 2	4.30	K	—	4	5364,6190,6267	1
359	S 2351	Vela	—	*10986*	10.5	−46 41	5.31	B 3 A	220	5	3961,4070,6266	1
360	—	Vela	—	10989	10.6	−46 16	R	B 3 A	—	1	0089	1
361	—	Puppis	—	10999	11.0	−40 31	R	B 5 A	—	1	7246	1
362	—	Vela	—	11024	11.7	−46 10	R	B 3 A	71	1	0089	1
363	S 2393	Puppis	q	11111	14.8	−36 21	4.53	A 5 F	164	2	5340,6258	1
364	S 2413	Volans	—	11201	17.2	−65 18	4.96	K	—	3	4004,6302,8246	2
365	S 2415	Puppis	w	11191	17.5	−32 44	4.77	K	—	2	9399,0110	1
366	S 2416	Puppis	—	11194	17.5	−36 10	5.33	B 3 A	—	1	6258	1
367	S 2433	Vela	B	11248	19.5	−48 10	4.83	B 2 A	18	3	9430,9450,0106	1
368	S 2437	Volans	κ^1	11293	20.1	−71 12	5.41	B 9 A	115	2	5417,6207	1
369	S 2439	Volans	κ^2	11297	20.2	−71 11	5.71	A	138	2	5417,6207	1
370	S 2441	Carina	ε	11285	20.4	−59 11	1.74	K Comp.	202	3	3992,4593,8194	2
371	S 2444	Chamæleon	α	11334	21.1	−76 36	4.06	F 5 G	—	5	4019,5432,6145	1
372	S 2468	Chamæleon	θ	11405	23.7	−77 10	4.19	K	—	5	4019,5432,6145	1
373	S 2481	Volans	β	11407	24.7	−65 48	3.61	K	—	5	4004,6302,8246	2
374	S 2490	Vela	A	11424	25.9	−47 36	5.51	B 5 A	—	1	0106	1
375	S 2536	Vela	C	11583	31.7	−49 36	4.91	K	—	2	9173,9420	1
376	S 2543	Carina	e^2	11624	33.0	−57 40	4.76	K	61	4	9121,9388,9419	1
377	S 2544	Carina	e^1	11622	33.0	−57 53	5.40	B 3 A	61	4	9121,9388,9419	1
378	S 2554	Vela	e	11653	34.2	−42 38	4.08	A 5 F	—	2	5355,6346	1
379	S 2572	Pyxis	β	11714	36.2	−34 57	3.92	G 5 K	—	2	5365,6366	1
380	S 2576	Vela	—	11733	36.6	−53 5	5.56	B 5 A	68	2	4503,8380	2
381	S 2577	Vela	—	11751	37.1	−52 42	5.41	B 5 A	—	2	4503,8380	2
382	S 2582	Vela	b	11755	37.3	−46 17	3.71	F 5 G Pec.	40,182	6	4502,4515,6259	2
383	S 2583	Vela	o	*11760*	37.4	−52 34	3.58	B 3 A	52	3	4503,6403,8380	2
384	S 2584	Vela	n	11770	37.9	−46 57	4.81	A 3 F	—	5	5451,6199,6405	2
385	S 2589	Vela	—	11786	38.5	−45 3	5.21	B 5 A	—	2	4515,6259	1
386	S 2590	Carina	d	11790	38.5	−59 24	4.40	B 2 A	—	3	5425,6191,7353	1
387	S 2595	Vela	—	11797	39.0	−47 44	5.48	B 3 A	—	3	6199,6405,8367	2
388	S 2599	Vela	—	11814	39.4	−52 44	5.68	B 9 A	—	2	4503,8380	2
389	S 2600	Vela	—	11817	39.5	−52 45	5.05	B 5 A	—	2	4503,8380	2
390	S 2602	Pyxis	α	11806	39.6	−32 49	3.72	B 2 A	—	7	4011,6268,8250	2
391	S 2614	Vela	d	11852	40.8	−42 17	3.98	G 5 K	—	5	5355,5490,5491	1
392	S 2623	Vela	δ	11887	42.0	−54 20	2.00	A	124	5	3981,3993,8216	2
393	S 2629	Vela	a	11900	42.6	−45 40	4.01	A	—	3	4515,6259,8368	2
394	S 2633	Vela	—	11917	43.1	−45 32	5.58	B 5 A	91	1	4515	1
395	S 2639	Carina	f	11956	44.1	−56 25	4.65	B 3 A	—	2	5469,6200	1
396	H 1621	Pyxis	γ	12006	46.3	−27 21	4.33	K 2 M	—	1	5396	1
397	S 2659	Vela	g	12013	46.4	−44 57	4.94	A 2 F	57	1	4515	1
398	S 2670	Vela	f	12035	47.1	−46 10	5.23	B	—	2	4515,8368	2
399	R	Vela	—	—	51.6	−47 13	R	Oa	—	1	5405	1
400	S 2702	Carina	—	12149	51.6	−59 59	5.96	B 3 A	—	2	4516,8276	2

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401	S 2706	Carina	c	12175	8 52.8	−60 16	3.95	B 8 A	—	2	4516,8276	2
402	S 2707	Vela	H	12180	53.3	−52 21	4.71	B 5 A	—	5	9093,9369,9382	1
403	S 2717	Carina	b^1	*12221*	54.5	−58 51	5.09	B 3 A	56	2	4516,8276	2
404	S 2727	Vela	—	12235	55.5	−46 51	5.21	F	—	3	4109,5405,7344	1
405	S 2729	Vela	w	12253	56.3	−40 52	4.37	F 8 G	—	4	9085,9394,9395	1
406	S 2737	Carina	b^2	12286	56.9	−58 42	5.23	F	132	1	4516	1
407	–	Vela	—	12298	57.5	−51 10	R	B 3 A	—	1	6212	1
408	S 2744	Vela	—	12297	57.6	−41 28	5.68	B 5 A	—	1	9395	1
409	S 2751	Vela	—	12330	58.7	−51 48	5.41	B 9 A	—	1	6212	1
410	–	Vela	—	12370	9 0.7	−47 3	R	B 3 A	—	3	4109,5405,7344	1
411	S 2761	Vela	c	12372	0.7	−46 42	3.74	K	—	4	4109,5405,6269	1
412	S 2762	Volans	α	12378	0.9	−66 0	4.13	A 5 F	—	2	4103,6245	1
413	S 2777	Vela	λ	12438	4.3	−43 2	2.10	K 5 M	205	9	3955,3956,3962	2
414	S 2787	Carina	E	12465	4.8	−70 8	4.76	*B 3 A*	18,79	4	5492,6222,6303	2
415	S 2788	Carina	G	12472	4.9	−72 12	4.53	F 5 G	176	3	5418,6236,6237	1
416	S 2802	Vela	—	12515	7.4	−44 27	5.04	B 5 A	—	1	8195	2
417	S 2808	Carina	a	12535	8.4	−58 33	3.51	B 3 A	—	13	3994,4071,4595	2
418	S 2814	Carina	i	12557	9.0	−61 54	4.20	B 3 A	—	2	5433,6316	1
419	S 2823	Carina	—	12590	10.4	−59 0	5.56	G 5 K	—	3	6356,6565,8260	2
420	S 2825	Vela	z	12593	10.6	−42 49	5.34	B 3 A	—	2	9103,0125	1
421	—	Vela	—	12600	11.0	−37 11	R	G	—	2	5438,6223	1
422	S 2834	Vela	—	12613	11.3	−55 9	5.19	K	132	1	6509	1
423	S 2838	Vela	l	12617	11.7	−38 9	4.80	K	—	1	7429	1
424	S 2841	Vela	k	12620	11.8	−37 0	4.70	F 5 G	—	3	5438,6223,7429	1
425	S 2844	Carina	β	12636	12.1	−69 18	1.73	A	124	8	3963,4062,4063	2
426	—	Carina	—	12638	12.6	−57 58	R	B 5 A	—	2	6406,8206	2
427	S 2849	Vela	—	12635	12.7	−43 51	4.94	K 5 M	210	2	9103,9406	1
428	S 2857	Carina	g	12652	13.4	−57 7	4.16	Ma	—	5	5506,6321,6406	2
429	S 2868	Carina	ι	12672	14.4	−58 51	2.24	F	—	14	3994,4071,4595	2
430	—	Vela	—	12723	16.5	−54 45	R	B 5 A	29	1	6509	1
431	H 1690	Pyxis	θ	12728	17.1	−25 32	4.93	Ma	—	1	5562	1
432	—	Carina	—	12759	18.1	−61 34	R	B 5 A	89	1	6316	1
433	S 2903	Carina	k	12782	18.5	−61 58	4.82	K	199	2	6316,7384	1
434	S 2907	Vela	—	12785	18.8	−55 5	5.70	A 2 F	138	1	6509	1
435	S 2911	Vela	κ	12788	19.0	−54 35	2.59	B 3 A	—	12	3995,6445,6467	2
436	—	Vela	—	12809	19.9	−47 51	R	B 5 A	—	1	9177	1
437	H 1700	Hydra	G	12868	22.7	−21 54	5.02	K	—	2	5567,7317	1
438	S 2958	Antlia	ε	12930	25.1	−35 30	4.40	K 2 M	—	1	6347	1
439	S 2978	Vela	ψ	12989	26.8	−40 1	3.53	F 5 G	—	4	4072,5574,6332	2
440	S 2996	Vela	N	13030	28.2	−56 36	2.98	K 5 M	—	4	4012,6330,7386	2
441	S 2999	Vela	—	13028	28.4	−40 13	5.37	K	—	1	4072	1
442	S 3004	Carina	R	13073	29.7	−62 21	var.	Md	216	5	7379,7384,8267	2
443	S 3006	Vela	—	13077	30.2	−48 34	5.31	B 3 A	—	2	5530,6331	1
444	S 3020	Carina	h	13112	31.5	−58 47	4.18	B 5 A	—	3	5507,6322,7413	1
445	—	Vela	—	13135	32.8	−48 18	R	F	172	2	5530,6331	1
446	S 3030	Vela	M	13145	33.3	−48 55	4.41	A 5 F	164	2	5530,6331	1
447	S 3053	Carina	m	13217	36.6	−60 53	4.56	B 9 A	—	3	5537,6278,6357	1
448	S 3084	Carina	l	13336	42.5	−62 3	var.	G	—	1	8267	2
449	S 3095	Carina	υ	*13389*	44.6	−64 37	2.99	F	221	3	4034,6433,8348	2
450	S 3110	Vela	u	13417	46.1	−45 16	5.30	B 8 A	111	2	6338,7375	1

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451	—	Vela	—	13440	9 46.9	−46 28	R	K	—	2	6338,7375	1
452	S 3119	Vela	—	13451	47.5	−45 44	5.61	K	—	2	6338,7375	1
453	—	Vela	—	13453	47.8	−46 3	R	B 8 A	109	1	6338	1
454	S 3121	Vela	m	13455	47.9	−46 5	4.45	G 5 K	109	2	6338,7375	1
455	H 1769	Hydra	—	13506	50.2	−18 32	5.29	Ma	—	1	4171	1
456	S 3155	Vela	φ	13593	53.4	−54 5	3.67	B 5 A	—	3	4079,6270,8402	2
457	H 1797	Leo	α	—	10 3.1	+12 28	1.42	B 8 A	18	3	3996,4086,6622	1
458	—	Carina	S	13882	6.2	−61 3	var.	Md	217	2	4013,4052	1
459	S 3260	Carina	—	13964	10.1	−61 9	6.68	B 3 A	—	2	4013,4052	1
460	S 3265	Vela	q	13968	10.6	−41 37	3.96	A 2 F	—	4	4080,6238,8247	2
461	S 3274	Carina	ω	14008	11.4	−69 32	3.61	B 8 A	18	5	4073,6304,6685	2
462	S 3293	Carina	q	14054	13.7	−60 50	3.42	K 5 M	205	7	4013,4051,4052	2
463	—	Vela	—	14083	15.0	−55 37	R	F 8 G	—	3	4710,6376,7376	1
464	S 3308	Vela	—	14105	15.8	−54 32	4.47	K	—	4	4710,6376,9396	1
465	S 3317	Vela	J	14145	17.2	−55 33	4.44	*B 5 A* Pec.	99	11	4710,6376,7376	1
466	S 3323	Vela	r	14156	18.1	−41 9	4.88	K 5 M	—	1	8485	2
467	—	Hydra	—	14204	19.9	−18 9	R	P	1	1	4087	1
468	—	Carina	—	14244	21.4	−58 5	R	F	—	1	4706	1
469	S 3359	Carina	I	14276	22.4	−73 32	4.02	F 5 G	—	2	4714,6424	1
470	S 3360	Antlia	α	14266	22.5	−30 34	4.23	K 5 M	206	5	4705,5508,6446	1
471	—	Carina	—	14283	22.7	−73 28	R	A 2 F	—	1	4714	1
472	S 3369	Carina	—	14295	23.7	−57 8	4.91	F 5 G Pec.	40,182	7	7430,9086,9094	1
473	S 3374	Carina	s	14304	24.2	−58 14	4.05	F	—	2	4706,6323	1
474	S 3380	Antlia	δ	14319	24.9	−30 6	5.82	B 9 A	—	2	4705,6446	1
475	—	Vela	—	14349	26.5	−56 34	R	B 8 A	110	2	9122,9249	1
476	S 3399	Carina	K	14383	27.8	−71 29	4.91	A 2 F	—	15	4715,4790,6260	2
477	S 3406	Carina	p	14392	28.5	−61 11	3.62	*B 5 A*	18,98	10	4035,4066,4074	2
478	S 3408	Carina	—	14405	28.7	−72 43	4.82	K 5 M	—	2	4714,6458	1
479	—	Carina	—	14404	29.0	−58 9	R	A 2 F	153	3	4053,4054,9094	1
480	—	Carina	—	14417	29.6	−57 41	R	B 8 A	—	2	9122,9249	1
481	S 3428	Carina	r	14478	31.8	−57 3	4.55	K 5 M	—	7	4053,9094,9122	1
482	—	Carina	—	*14483*	31.8	−57 41	R	B	24,230	3	4053,9122,9249	1
483	S 3429	Carina	—	14489	32.0	−57 43	R	B	24	2	4053,4054	1
484	S 3432	Carina	t^1	14504	32.6	−59 3	5.28	K	—	3	4005,4053,4709	1
485	S 3436	Vela	p	14517	33.2	−47 43	3.99	F 2 G	174	4	4081,6317,8403	2
486	—	Carina	—	14528	33.6	−58 13	R	A 2 F	153	2	4053,9094	1
487	—	Carina	—	14536	34.2	−56 44	R	B 3 A	—	4	9094,9122,9249	1
488	S 3446	Chamæleon	γ	14557	34.3	−78 6	4.09	Ma	—	3	4717,6414,6686	1
489	S 3452	Carina	t^2	*14558*	34.9	−58 40	4.74	K 5 M	208	1	4709	1
490	—	Carina	—	14566	35.2	−58 18	R	Mb	68	2	4054,4709	1
491	S 3454	Vela	x	14569	35.3	−55 5	4.40	G	189,192	3	4716,6339,7414	1
492	—	Vela	—	14571	35.4	−55 28	R	B 3 A	29,58	1	6339	1
493	S 3455	Vela	—	14573	35.4	−55 5	6.62	B 8 A	—	1	6339	1
494	—	Carina	—	14583	35.7	−60 28	R	B 3 A	—	1	6480	1
495	—	Carina	—	14606	36.8	−64 35	R	A	138	4	3958,4036,5563	1
496	—	Carina	—	14623	37.4	−59 27	R	B 3 A	68	2	4709,6480	1
497	S 3465	Carina	—	14626	37.4	−59 9	6.48	Oc Pec.	10	13	4005,4044,4709	1
498	—	Vela	—	14624	37.5	−55 33	R	A	133	1	6339	1
499	R	Carina	—	—	37.8	−58 15	R	Oa	—	4	4005,4053,4054	1
500	S 3472	Carina	—	14653	38.7	−63 57	5.18	B 3 A	—	6	3958,3967,4036	1

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501	S 3474	Carina	—	14656	10 38.9	−58 42	5.51	B 3 A Pec.	40,72	3	4044,4053,4709	1
502	S 3475	Carina	—	14663	39.2	−60 28	7.58	B 3 A	58	1	6480	1
503	—	Carina	—	14664	39.3	−60 39	R	B 5 A	—	2	5568,6480	1
504	S 3476	Carina	θ	14667	39.4	−63 52	3.01	B	23	15	3957,3958,3964	2
505	S 3477	Carina	w	14673	39.7	−60 3	4.44	K 5 M	—	14	4005,4044,4709	1
506	S 3479	Carina	—	14684	40.1	−59 36	6.68	Oc Pec.	9	14	4005,4044,4709	1
507	—	Carina	—	14691	40.3	−59 12	R	Oc	8	3	4709,6480,6592	1
508	—	Carina	—	14692	40.3	−63 44	R	B 3 A	—	3	3958,4036,6487	1
509	S 3482	Carina	—	14702	40.5	−63 26	5.12	B 3 A	—	7	3958,3964,3967	1
510	—	Carina	—	14698	40.6	−59 28	R	B	27	3	4044,4709,6480	1
511	—	Chamæleon	—	14730	40.8	−79 16	R	B 5 A	89	1	6686	1
512	S 3485	Carina	η	14720	41.2	−59 10	var.	Q	2	11	4005,4044,4709	1
513	—	Carina	—	14743	41.7	−71 55	R	F 8 G	—	1	6458	1
514	S 3495	Vela	μ	14751	42.5	−48 54	2.81	G 5 K	—	9	3959,5439,6281	2
515	S 3496	Carina	—	14754	42.5	−60 5	6.38	A	133	4	4044,4709,4846	1
516	—	Carina	—	14764	42.7	−63 59	R	B 5 A	68	1	6487	1
517	S 3498	Carina	—	14769	42.8	−63 44	5.45	B 8 A	68	4	3958,4036,5563	1
518	S 3502	Carina	—	14775	43.2	−63 52	5.05	B 5 A	—	6	3958,3967,4036	1
519	—	Carina	—	14788	43.9	−59 21	R	B 5 A	—	6	4044,4709,4846	1
520	—	Carina	—	14797	44.2	−59 24	R	A 2 F	40	6	4044,4709,4846	1
521	S 3510	Chamæleon	δ^1	14817	44.4	−79 57	5.48	K	—	2	4834,6416	1
522	—	Carina	—	14811	44.8	−59 42	R	Oe 5 B	17	1	6480	1
523	S 3517	Chamæleon	δ^2	14829	44.9	−80 1	4.62	B 3 A	—	3	4726,4834,6416	1
524	—	Carina	—	14827	45.5	−58 48	R	A	—	1	4709	1
525	—	Carina	—	14846	46.8	−60 44	R	B 5 A	—	1	6480	1
526	—	Carina	—	14902	49.3	−58 22	R	B 3 A	—	3	4050,6425,7380	1
527	S 3555	Carina	—	14903	49.3	−60 17	7.44	B 1 A	—	1	6480	1
528	S 3556	Carina	u	*14910*	49.4	−58 19	3.85	K	199,222	10	4021,4050,5575	2
529	—	Vela	—	14935	50.5	−41 43	R	A	137	2	4727,6436	1
530	S 3570	Carina	T	14955	51.3	−59 59	6.03	K	199	2	4050,4846	1
531	—	Carina	—	14965	52.0	−59 51	R	Q	3	1	4050	1
532	S 3574	Antlia	ι	14963	52.1	−36 36	4.61	K	—	5	4184,4732,6368	1
533	S 3576	Carina	—	14971	52.2	−59 55	7.64	Q	4	1	4050	1
534	—	Carina	—	15004	53.7	−59 12	R	F	—	1	4050	1
535	S 3601	Vela	i	15048	55.5	−41 41	4.58	A 2 F	—	2	4727,6436	1
536	—	Carina	—	15152	59.8	−57 25	R	B 3 A	—	1	4064	1
537	H 1932	Hydra	χ^1	15166	11 0.5	−26 45	5.19	F 5 G	—	2	4762,6481	1
538	—	Carina	—	15175	0.7	−59 19	R	B	—	1	4065	1
539	H 1933	Hydra	χ^2	15183	1.1	−26 45	5.55	B 8 A	106	2	4762,6481	1
540	—	Carina	—	15204	1.9	−59 25	R	B 3 A	—	6	4050,4065,4733	1
541	S 3659	Carina	—	15215	2.3	−58 7	6.04	K	—	2	4064,4733	1
542	S 3662	Carina	z	15222	2.4	−61 53	4.80	K	—	7	9104,9174,9383	1
543	H 1942	Hydra	—	15253	3.9	−27 32	5.35	A 2 F	—	2	4762,6481	1
544	S 3678	Carina	x	15266	4.4	−58 26	4.03	F 8 G Pec.	40,186	4	4043,4064,4733	1
545	S 3679	Carina	—	15269	4.4	−61 24	5.47	A	140	3	9174,9634,9732	1
546	—	Carina	—	15293	5.4	−58 18	R	F 8 G	184	2	4064,4733	1
547	S 3692	Carina	—	15305	5.8	−60 26	8.06	Oa	—	3	4065,4754,7355	1
548	—	Carina	—	15318	6.6	−57 55	R	B 8 A	—	2	4064,4733	1
549	H 1946	Crater	β	15317	6.7	−22 17	4.42	A 2 F	—	3	4763,7398,7399	1
550	—	Carina	—	15344	7.7	−57 53	R	Mb	—	2	4064,4733	1

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551	S 3716	Carina	y	15356	11	8.3	− 59	46	4.73	F 5 G Pec.	40,182	7	4065,4754,6291	1
552	—	Carina	—	15377		9.2	− 59	4	R	B 3 A	—	7	4065,4733,4754	1
553	S 3774	Centaurus	π	15539		16.4	− 53	56	4.38	B 5 A	18	5	4744,4745,6437	1
554	S 3785	Centaurus	—	15571		18.4	− 35	37	5.00	K 5 M	—	2	9112,9252	1
555	S 3794	Centaurus	—	15619		20.6	− 35	31	5.44	K	—	2	9112,9252	1
556	S 3840	Centaurus	o^1	15755		27.1	− 58	53	4.93	F 8 G Pec.	157,187	6	4728,6340,7356	1
557	S 3841	Centaurus	o^2	15756		27.1	− 58	58	5.30	A 2 F Pec.	156,157	6	4728,6340,7356	1
558	S 3848	Hydra	—	15777		27.9	− 30	32	4.94	Ma	—	1	4037	1
559	—	Centaurus	—	15779		27.9	− 59	10	R	A 2 F	133	2	6340,7377	1
560	S 3853	Hydra	ξ	15786		28.1	− 31	18	3.65	G 5 K	—	3	4037,5641,8252	2
561	S 3871	Centaurus	A	15825		30.0	− 53	42	4.79	B 8 A	—	7	4771,5564,6377	1
562	S 3883	Centaurus	λ	15848		31.1	− 62	28	3.31	B 9 A	—	7	4014,6417,6499	2
563	—	Centaurus	—	15862		31.8	− 60	30	R	B 3 A	—	1	4707	1
564	S 3893	Centaurus	—	15877		32.4	− 60	44	5.21	K	—	2	4707,5591	1
565	S 3905	Centaurus	—	15901		33.5	− 61	16	5.38	A	—	2	4707,5591	1
566	S 3918	Hydra	o	15950		35.2	− 34	11	4.98	B 8 A	—	2	4784,5584	1
567	—	Centaurus	—	15962		35.9	− 53	24	R	Ma	—	1	6377	1
568	S 3927	Centaurus	—	15975		36.2	− 61	32	4.85	G	—	3	4707,5591,6499	1
569	S 3933	Hydra	—	*15986*		36.7	− 31	56	4.98	K 5 M	209	5	9123,9371,9401	1
570	S 3949	Centaurus	—	16039		38.8	− 61	56	5.17	F 8 G Pec.	40,187	2	6417,6499	1
571	S 3962	Centaurus	—	16080		40.8	− 45	8	5.42	B 8 A	57	2	4711,5596	1
572	S 3963	Musca	λ	16085		40.9	− 66	10	3.77	A 5 F	—	5	4038,6349,7590	2
573	S 3966	Centaurus	—	16100		41.7	− 60	37	4.28	G	—	2	4707,5591	1
574	S 3978	Musca	μ	16133		43.4	− 66	15	4.69	K 5 M	—	2	4038,6349	1
575	H 2024	Hydra	—	16139		43.7	− 26	11	5.67	Mb	—	1	4166	1
576	S 3987	Centaurus	j	16151		44.8	− 63	14	4.62	B 5 A	18	5	4772,5603,6426	1
577	S 3990	Musca	—	16162		45.2	− 69	40	4.92	G 5 K	—	2	9087,9175	1
578	S 3995	Centaurus	B	16179		46.1	− 44	37	4.59	K	—	2	4711,5596	1
579	S 4005	Hydra	β	16217		47.9	− 33	21	4.47	B 9 A	—	2	4764,5598	1
580	—	Centaurus	—	16263		50.0	− 62	43	R	A 2 F	153	2	4772,6426.	1
581	—	Crux	—	16329		52.6	− 61	53	R	B 5 A	—	1	6324	1
582	—	Crux	—	16359		53.7	− 63	47	R	A 2 F	153	2	4772,6426	1
583	S 4039	Chamæleon	ε	16382		54.7	− 77	40	5.06	B 9 A	—	2	4746,6577	1
584	S 4059	Crux	θ^1	16451		58.0	− 62	45	4.47	A 5 F	—	3	4718,4828,6324	1
585	S 4066	Crux	θ^2	16479		59.2	− 62	36	4.94	B 3 A	—	3	4718,4828,6324	1
586	S 4069	Chamæleon	κ	16484		59.6	− 75	57	4.93	K 5 M	68	2	9095,9178	1
587	S 4083	Crux	η	16541	12	1.7	− 64	3	4.31	F	—	5	4785,4835,6350	1
588	S 4089	Centaurus	—	*16566*		2.9	− 50	6	4.79	B 5 A	92	6	6469,7461,7514	2
589	S 4093	Centaurus	δ	16572		3.2	− 50	10	2.81	*B 3 A*	18,74	9	4104,6469,7461	2
590	H 2060	Corvus	α	16576		3.3	− 24	10	4.32	F 2 G	—	2	6470,6500	1
591	H 2063	Corvus	ε	16615		5.0	− 22	3	3.14	K	—	4	4119,6611,6668	2
592	H 2066	Corvus	—	16634		5.9	− 23	2	5.25	A 2 F	—	3	4119,6611,6668	1
593	S 4107	Centaurus	ρ	16652		6.4	− 51	48	4.15	B 3 A	—	4	4708,5600,6351	1
594	—	Crux	—	16704		8.9	− 63	51	R	B 1 A	29	2	4773,6488	1
595	S 4134	Crux	δ	16726		9.8	− 58	11	3.08	B 3 A	18	5	4015,6359,7584	2
596	S 4147	Musca	ε	16761		12.1	− 67	24	4.15	Mb	214	3	4791,5576,6669	1
597	S 4148	Chamæleon	β	16766		12.5	− 78	45	4.34	B 5 A	18	2	4792,5607	1
598	S 4153	Crux	ζ	16778		13.0	− 63	26	4.25	B 3 A	—	3	4773,6378,6488	1
599	S 4157	Centaurus	F	16793		13.6	− 54	35	4.97	Ma	—	2	9105,9253	1
600	S 4173	Crux	ε	16835		15.9	− 59	51	3.53	K 2 M	—	8	4075,4847,4881	2

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601	S 4176	Musca	ζ²	16845	12 16.6	−66 58	5.30	A 5 F	—	2	5576,6669	1
602	—	Musca	ζ¹	16847	16.6	−67 45	R	K	—	3	4791,5576,6669	1
603	—	Musca	—	16878	17.9	−67 5	R	K	—	1	6669	1
604	—	Crux	—	16939	21.0	−62 34	R	B 5 A	90	6	4076,4090,6418	1
605	S 4207	Centaurus	G	16946	21.1	−50 53	5.07	B 3 A	57,58	2	4802,6489	1
606	S 4208	Crux	α¹	16942	21.1	−62 32	1.02	B 1 A	18,32	13	4076,4090,4591	2
607	S 4209	Crux	α²	16943	21.1	−62 32						
608	—	Crux	—	16959	21.8	−63 14	R	B 8 A	—	2	4773,6488	1
609	S 4222	Centaurus	σ	16976	22.6	−49 40	4.14	B 3 A	—	5	4703,4802,6397	1
610	—	Crux	—	16978	22.7	−63 47	R	A	133	2	4773,6488	1
611	S 4242	Crux	γ	17048	25.6	−56 33	1.55	Mb	—	9	3982,3988,3989	2
612	S 4245	Musca	—	17061	26.1	−72 27	5.96	K	—	1	6501	1
613	S 4247	Musca	γ	17072	26.5	−71 35	4.01	B 5 A	18	9	4022,4165,5577	2
614	H 2134	Corvus	β	17129	29.1	−22 50	2.81	G 5 K	—	5	4111,6438,7507	2
615	S 4264	Centaurus	—	17149	30.6	−39 19	5.95	A	—	4	4719,6427,6536	1
616	S 4270	Musca	α	17156	31.3	−68 35	2.91	B 3 A	—	6	4122,6409,6486	2
617	S 4276	Centaurus	τ	17180	32.3	−47 59	3.99	A 2 F	—	6	4123,4857,6293	2
618	S 4289	Centaurus	l	17234	34.4	−39 26	4.71	B 8 A	107	6	4719,5597,6427	1
619	S 4294	Centaurus	γ	17269	36.0	−48 24	2.36	A	124	8	4123,4857,6293	2
620	S 4297	Crux	—	17270	36.2	−59 8	5.04	B 8 A	—	2	3975,3976	1
621	S 4301	Centaurus	w	17300	37.1	−48 16	4.63	K	—	3	4857,6360,6652	1
622	—	Centaurus	—	17320	38.0	−39 38	R	A 5 F	—	4	4719,6427,6536	1
623	S 4310	Crux	ι	17366	39.7	−60 26	4.71	K	—	2	9113,9266	1
624	S 4312	Musca	β	17374	40.1	−67 33	3.26	B 3 A	18	13	4016,6294,6552	2
625	S 4317	Crux	—	17390	40.6	−55 56	4.93	B 3 A	—	2	9124,9268	1
626	S 4324	Crux	β	17411	41.8	−59 8	1.49	B 1 A	30,31	19	3975,3976,4192	2
627	—	Centaurus	—	17460	44.7	−47 55	R	A	133	3	4729,4893,5642	1
628	—	Crux	—	17472	45.4	−59 47	R	A 2 F	152	2	9113,9266	1
629	—	Centaurus	—	17489	46.5	−39 8	R	B 8 A	—	1	6639	1
630	—	Centaurus	—	17488	46.5	−47 33	R	A	133	3	4729,4893,5642	1
631	S 4352	Crux	—	17504	47.4	−59 47	5.78	A	135	2	9113,9266	1
632	S 4354	Centaurus	e	17506	47.5	−48 24	4.36	K 2 M	—	4	4729,4893,5578	1
633	S 4361	Centaurus	n	17521	47.9	−39 38	4.31	A 5 F	—	5	4755,5539,6398	1
634	S 4365	Crux	λ	17540	48.7	−58 36	4.84	B 3 A	59	15	3975,3976,7524	2
635	S 4366	Crux	—	17542	48.8	−56 37	5.42	*B 3 A*	53	6	4734,4814,4836	1
636	S 4367	Crux	μ	17541	48.8	−56 38	4.29	B 3 A	53	6	4734,4814,4836	1
637	S 4373	Crux	—	17572	50.1	−56 17	5.62	Oe 5 B	14	4	4734,6390,6447	1
638	S 4402	Musca	δ	17693	55.4	−71 0	3.60	K 2 M	—	6	4017,4154,6296	2
639	—	Musca	—	17717	56.3	−70 56	R	*B 3 A*	18,80	2	6448,7634	2
640	S 4412	Centaurus	ξ¹	17747	57.7	−48 59	5.00	A	124	3	4747,5592,9817	1
641	S 4422	Centaurus	f	17811	13 0.4	−47 56	4.94	B 3 A	60	6	9088,9372,9426	1
642	S 4425	Centaurus	ξ²	17826	1.0	−49 22	4.36	B 3 A	—	2	4747,5592	1
643	S 4432	Musca	θ	*17840*	1.7	−64 46	5.64	Oa Pec.	6	2	4082,4088	1
644	—	Musca	—	17843	1.8	−67 16	R	Ma	—	1	9114	1
645	S 4453	Centaurus	—	17936	6.0	−59 23	4.74	B 8 A	—	11	9096,9176,9384	1
646	—	Musca	—	17939	6.2	−65 42	R	A	—	4	4082,4088,9250	1
647	S 4461	Centaurus	—	17949	6.5	−37 16	4.82	G 5 K	—	4	4765,5585,6459	1
648	S 4467	Centaurus	—	17977	8.0	−58 34	4.99	F 8 G	—	11	9096,9106,9176	1
649	S 4470	Musca	η	17989	8.5	−67 22	4.91	B 8 A	—	7	9114,9378,9409	1
650	—	Musca	—	18031	10.1	−64 36	R	F 5 G	—	2	4082,4088	1

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651	S 4480	Musca	—	18039	13	10.5	−66	15	4.82	K	—	8	9250,9403,9459	1
652	H 2249	Hydra	γ	18121		13.5	−22	39	3.35	G 5 K	—	8	4023,6379,6513	2
653	—	Musca	—	18135		14.6	−67	1	R	B 3 A	—	1	9114	1
654	S 4507	Centaurus	ι	18149		15.0	−36	11	2.98	A 2 F	—	5	4124,5684,8296	2
655	S 4514	Centaurus	—	18172		16.1	−60	27	6.60	B 3 A	70	5	4712,4870,4892	1
656	S 4515	Centaurus	J	18174		16.2	−60	28	4.56	B 5 A	70	6	4712,4829,4870	1
657	S 4521	Centaurus	m	18202		17.2	−64	1	4.43	G	—	5	9131,9373,9436	1
658	S 4522	Musca	ι^1	18192		17.2	−74	22	4.90	K	—	6	9132,9390,9466	1
659	—	Centaurus	—	18232		18.6	−63	58	R	F 5 G	—	2	9131,9473	1
660	H 2263	Virgo	α	18262		19.9	−10	38	1.23	B 2 A	18	4	3985,3997,4089	1
661	S 4541	Centaurus	—	18268		20.3	−39	14	5.12	K	—	3	3977,4736,5599	1
662	S 4567	Centaurus	d	18376		25.2	−38	54	3.95	K	199	2	4736,5599	1
663	S 4610	Centaurus	ε	18559		33.6	−52	58	2.58	B 1 A	—	6	4125,6439,6440	2
664	—	Centaurus	—	18566		33.8	−49	27	R	Mb	—	1	4106	1
665	—	Centaurus	—	18646		38.0	−50	31	R	A	137	6	4803,4837,5655	1
666	S 4641	Centaurus	i	18696		40.0	−32	33	4.25	F 5 G	—	4	4748,5654,7374	1
667	S 4646	Centaurus	M	18700		40.4	−50	56	4.61	K	199	6	4803,4837,5655	1
668	—	Centaurus	—	18716		41.2	−49	45	R	A 3 F	—	2	4837,6562	1
669	S 4653	Centaurus	—	18720		41.4	−49	50	5.56	K	—	2	4837,6562	1
670	S 4672	Centaurus	ν	18772		43.5	−41	12	3.54	B 2 A	—	6	4112,4126,5619	2
671	S 4675	Centaurus	g	18779		43.6	−33	58	4.28	Mb	214	2	4756,5601	1
672	S 4676	Centaurus	μ	18773		43.6	−41	59	3.33	*B 2 A*	47	6	4112,4126,5619	2
673	S 4685	Centaurus	—	18819		45.6	−46	25	5.85	B 3 A	—	2	9694,9700	1
674	S 4690	Centaurus	k	*18833*		46.0	−32	30	4.35	B 5 A	224	9	4720,4830,5540	1
675	—	Centaurus	—	18839		46.3	−31	8	R	F 8 G	—	1	6570	1
676	S 4701	Centaurus	h	*18855*		47.4	−31	27	4.88	B 5 A	223	5	5540,5601,6570	1
677	—	Centaurus	—	18859		47.7	−46	39	R	*B 3 A*	81	2	9694,9700	1
678	S 4715	Centaurus	ζ	18897		49.3	−46	47	2.81	B 2 A Pec.	45	67	4127,5628,7591	2
679	—	Centaurus	—	18918		50.0	−30	47	R	K	—	1	6570	1
680	S 4724	Centaurus	—	18920		50.4	−63	11	4.76	K	—	2	9120,9260	1
681	—	Centaurus	—	18929		50.5	−45	53	R	B 5 A	57	1	6399	1
682	S 4731	Centaurus	φ	18960		52.2	−41	36	4.04	B 3 A	—	5	4193,4816,5634	2
683	S 4732	Centaurus	υ^1	18968		52.5	−44	19	4.05	B 3 A	—	8	4216,4766,5593	1
684	—	Centaurus	—	18995		54.0	−45	38	R	A 2 F	68	1	6399	1
685	S 4748	Centaurus	υ^2	19027		55.4	−45	7	4.50	F 5 G	180	9	4766,5593,5629	1
686	S 4749	Apus	θ	19014		55.6	−76	19	5.68	Mb	214	2	4039,4067	1
687	S 4753	Centaurus	β	19043		56.7	−59	53	0.83	B 1 A	—	26	3984,4055,4056	3
688	S 4757	Octans	—	19007		56.9	−84	4	6.92	K	132	1	6653	1
689	—	Centaurus	—	19057		57.4	−40	56	R	A	137	3	5652,6419,6472	1
690	S 4772	Centaurus	χ	19107		59.9	−40	42	4.59	B 3 A	—	6	4749,4849,5652	1
691	H 2378	Hydra	π	19128	14	0.7	−26	12	3.51	K	—	8	4155,5685,6428	2
692	S 4775	Centaurus	θ	19129		0.8	−35	52	2.19	K	199	6	4128,5670,5695	2
693	S 4798	Centaurus	—	19179		3.3	−52	57	4.83	K	—	2	9125,9254	1
694	S 4820	Centaurus	—	19273		8.0	−56	37	5.22	*B 3 A*	18,81	4	4767,5100,5565	1
695	S 4828	Apus	—	19271		9.6	−82	23	R	B 8 A	68	1	6653	1
696	S 4837	Octans	δ	19284		10.9	−83	13	4.10	K 2 M	—	7	4774,4858,4882	1
697	H 2400	Boötes	α	—		11.1	+19	44	0.03	K	—	5	3986,3987,3998	3
698	S 4845	Lupus	ι	19354		13.0	−45	36	3.91	B 3 A	18	6	4172,5612,8385	2
699	S 4848	Centaurus	v	19358		13.3	−55	56	4.36	B 5 A	—	5	4767,4871,5100	1
700	S 4853	Lupus	—	19379		14.3	−44	43	4.81	F	—	3	4172,5612,8480	2

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701	S 4854	Centaurus	ψ	19387	14	14.5	−37	26	4.19	A	128	2	4786,6361	1
702	S 4858	Centaurus	—	*19406*		15.5	−58	0	4.95	G	225	3	9107,9133,9269	1
703	S 4866	Centaurus	a	19445		16.8	−39	3	4.61	B 5 A	94	3	4817,5897,6371	1
704	H 2417	Hydra	k	19455		17.3	−27	18	4.90	K 2 M	—	6	4713,5129,6461	1
705	—	Hydra	—	19473		18.1	−29	13	R	A 2 F	133	2	6845,7439	1
706	S 4879	Lupus	τ¹	19514		19.7	−44	46	4.58	B 3 A	54	2	4787,5604	1
707	S 4880	Lupus	τ²	19515		19.8	−44	56	4.35	F 8 G	54	2	4787,5604	1
708	—	Lupus	—	19540		20.8	−45	41	R	A 3 F	161	2	4787,5604	1
709	H 2427	Hydra	l	19577		22.4	−29	3	5.01	B 8 A	—	4	4793,6362,6845	1
710	—	Hydra	—	19593		23.4	−28	40	R	F 8 G	68	1	6845	1
711	S 4896	Lupus	—	19598		23.7	−44	53	5.61	B 9 A	122	2	4787,5604	1
712	S 4897	Lupus	—	19597		23.7	−49	4	5.54	A 2 F	—	1	4804	1
713	S 4921	Lupus	σ	19661		25.9	−50	1	4.61	B 2 A	—	7	4731,4804,5664	1
714	S 4941	Centaurus	η	19737		29.2	−41	43	2.54	*B 3 A* Comp.	83	34	4156,5759,7508	2
715	S 4950	Lupus	ρ	19785		31.2	−49	0	4.04	B 5 A	18	2	4788,6380	1
716	S 4960	Centaurus	α¹	19825		32.8	−60	25	0.20	G	188	23	3983,4592,5162	3
717	S 4961	Centaurus	α²	19826		32.8	−60	25		K 5 M	188	21	4592,5162,5760	3
718	S 4969	Circinus	α	19849		34.4	−64	33	3.37	F	166	7	4185,6400,6514	2
719	S 4972	Centaurus	—	19867		34.9	−35	43	5.82	A	139	3	4775,5602,6515	1
720	S 4975	Lupus	α	19873		35.2	−46	57	2.46	B 2 A	—	8	4129,5861,6603	2
721	S 4976	Apus	α	19851		35.4	−78	38	3.80	K 5 M	206	12	4092,4859,5697	2
722	S 4978	Centaurus	b	19890		35.7	−37	21	4.17	B 3 A	—	3	4167,4173,5613	1
723	H 2456	Libra	—	19930		37.4	−24	34	5.85	B 9 A	122	2	4831,7455	1
724	S 4987	Centaurus	c¹	19931		37.5	−34	44	3.76	K	—	3	4775,5602,6515	1
725	S 4993	Centaurus	c²	19958		38.8	−34	46	4.96	A	18	3	4775,5602,6515	1
726	H 2463	Hydra	m	*19997*		40.2	−25	1	5.04	F 5 G	175	5	4831,5656,5928	1
727	H 2469	Hydra	—	20035		41.5	−25	12	5.84	A	140	2	4831,7455	1
728	H 2471	Hydra	—	20044		42.0	−25	40	5.68	G 5 K	—	2	4831,7455	1
729	H 2472	Hydra	—	20048		42.2	−26	13	6.07	B 9 A	—	3	4831,5049,5542	1
730	S 5032	Octans	π¹	20034		44.2	−82	49	5.60	K	—	2	4774,6594	1
731	H 2477	Hydra	E	20100		44.5	−27	32	4.96	K 2 M	—	8	4794,5049,5542	1
732	S 5034	Lupus	ο	20109		45.1	−43	9	4.43	B 5 A	—	6	4805,5570,5579	1
733	—	Hydra	—	20181		48.4	−27	56	R	K	—	1	6613	1
734	H 2490	Libra	—	20184		48.5	−24	14	5.69	K	—	1	6563	1
735	S 5081	Lupus	β	20263		52.0	−42	44	2.74	B 2 A Pec.	44	58	4130,5873,5874	2
736	S 5085	Centaurus	κ	20286		52.6	−41	42	3.36	B 3 A	50	32	4130,5886,7586	2
737	H 2503	Hydra	—	20295		52.8	−27	15	5.83	A 5 F	68	1	4850	1
738	H 2507	Hydra	—	20376		56.2	−27	40	5.66	A 5 F	68	1	4850	1
739	H 2514	Libra	σ	20431		58.3	−24	53	3.25	Mb	—	8	4186,4187,4189	2
740	S 5119	Lupus	π	20428		58.3	−46	40	3.84	B 5 A	—	3	4838,5920,6538	1
741	—	Lupus	—	20450		59.1	−48	30	R	B 3 A	—	1	4839	1
742	—	Lupus	—	20463		59.8	−51	39	R	B 3 A	—	2	6450,6604	1
743	—	Lupus	—	20478	15	0.4	−48	42	R	K	—	1	4839	1
744	S 5143	Lupus	λ	20514		2.1	−44	54	4.34	B 3 A	—	2	4822,5698	1
745	S 5157	Lupus	—	*20566*		4.8	−44	54	6.31	K	200	1	5698	1
746	S 5161	Lupus	κ	20570		5.0	−48	22	4.17	B 9 A	118	5	4839,5761,8558	2
747	S 5162	Lupus	—	20571		5.0	−48	22	5.94	A	118	2	4839,5761	1
748	S 5163	Lupus	ζ	20572		5.1	−51	43	3.46	K	199	9	4188,5887,6450	2
749	S 5170	Lupus	e	20591		6.1	−44	8	4.97	B 3 A	—	2	9089,9251	1
750	—	Circinus	—	20640		8.5	−60	32	R	B 1 A	—	7	9566,9579,9586	1

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751	—	Lupus	—	20655	15 8.9	−47 42	R	A 2 F	—	4	4759,4839,6381	1
752	S 5186	Circinus	δ	20649	8.9	−60 35	5.25	Oe 5 B	—	11	9443,9451,9566	1
753	S 5188	Circinus	ε	20654	9.2	−63 15	4.85	K	—	2	9115,9267	1
754	—	Lupus	—	20670	9.5	−43 7	R	B 5 A	—	2	9089,9251	1
755	S 5193	Circinus	β	20668	9.6	−58 26	4.00	A 3 F	—	5	4795,4883,5101	1
756	S 5194	Triang. Aust.	γ	20657	9.6	−68 19	3.00	A	18	10	4131,5626,6393	2
757	—	Lupus	—	20686	9.9	−47 30	R	K	—	1	6539	1
758	S 5201	Circinus	—	20695	10.8	−60 8	5.35	Oe 5 B	—	13	9443,9451,9491	1
759	—	Lupus	—	20716	11.5	−40 42	R	A 5 F	—	2	5050,8658	2
760	S 5207	Lupus	μ	*20713*	11.5	−47 31	4.18	B 8 A	226	4	4757,5609,6381	1
761	H 2540	Lupus	f	20721	11.7	−29 47	4.69	K	199	2	4738,5666	1
762	S 5214	Lupus	—	20731	12.4	−40 26	5.69	B 8 A	—	4	5050,6474,7592	2
763	S 5220	Lupus	δ	20779	14.8	−40 18	3.37	B 2 A	18	6	4194,5050,6352	2
764	S 5223	Lupus	—	20782	15.0	−40 24	6.13	A 2 F	138	1	5050	1
765	—	Lupus	—	20787	15.1	−37 52	R	A	138	1	5643	1
766	S 5226	Lupus	ν^1	20786	15.1	−47 34	4.98	F 8 G	—	4	4757,5609,6381	1
767	S 5227	Lupus	ν^2	20783	15.1	−47 57	5.66	G	—	4	4757,5609,6381	1
768	S 5228	Circinus	—	20775	15.1	−60 18	5.58	F 5 G	—	5	9451,9566,9603	1
769	S 5229	Circinus	γ	20785	15.4	−58 58	4.41	B 5 A Comp.	102	8	4768,4795,4883	1
770	S 5230	Lupus	ϕ^1	20793	15.5	−35 54	3.28	K 5 M	—	9	4195,4721,5108	2
771	—	Lupus	—	20801	15.8	−43 56	R	A 2 F	133	2	5069,6306	1
772	S 5231	Lupus	ε	20806	15.9	−44 20	3.56	B 3 A	—	5	5069,6306,8410	2
773	S 5237	Lupus	ϕ^2	20825	16.8	−36 30	4.69	B 3 A	18	9	4195,4721,5108	2
774	S 5245	Lupus	υ	20847	18.2	−39 22	5.33	A	137	4	4776,5643,6298	1
775	S 5251	Lupus	k	20861	18.8	−38 22	4.63	A	—	5	4776,5643,6298	1
776	S 5263	Apus	κ^1	20878	20.6	−73 2	5.61	*B 5 A* Pec.	100	7	6794,6801,9596	1
777	S 5264	Lupus	—	20909	20.9	−36 25	5.60	B 5 A	—	6	4721,5108,5605	2
778	S 5282	Lupus	—	20948	22.4	−46 23	4.88	K	—	3	9261,9398,9427	1
779	—	Lupus	—	20959	22.8	−38 17	R	A 5 F	133	3	5643,6462,6546	1
780	S 5305	Triang. Aust.	ε	21051	27.6	−65 59	4.07	K	—	4	4806,4860,6451	1
781	H 2585	Libra	—	21090	28.5	−27 42	5.26	K	—	4	4218,5051,6529	1
782	S 5310	Lupus	γ	21084	28.5	−40 50	2.96	B 3 A	18	4	4157,5677,7578	2
783	S 5312	Lupus	d	21095	29.0	−44 37	4.76	B 3 A	—	7	4818,4897,5130	1
784	S 5313	Apus	κ^2	21078	29.2	−73 7	5.76	B 8 A	—	7	6794,6801,9596	1
785	S 5315	Lupus	—	21102	29.3	−44 4	5.29	K 5 M	—	4	4818,4897,5130	1
786	H 2595	Libra	υ	21146	30.9	−27 48	3.93	K 2 M	—	11	4218,5051,5935	2
787	S 5324	Lupus	ω	21153	31.3	−42 14	4.04	K 5 M	206	9	4872,5084,5131	1
788	H 2601	Libra	τ	21186	32.6	−29 27	3.91	B 3 A	—	5	4158,5109,5615	2
789	S 5337	Lupus	ψ^1	21207	33.4	−34 5	4.44	K	199	6	4861,4894,4896	1
790	—	Lupus	—	*21206*	33.5	−43 58	R	A	136	4	4897,6353,6571	1
791	S 5344	Lupus	g	21226	34.3	−44 20	4.51	F 5 G	—	11	4818,4897,5130	1
792	S 5356	Lupus	ψ^2	21274	36.3	−34 28	4.75	B 5 A	—	5	4861,4894,5635	1
793	S 5387	Lupus	—	21360	40.4	−34 22	5.65	B 8 A	—	3	4861,4894,5945	1
794	S 5410	Lupus	χ	21454	44.6	−33 20	4.20	B 9 A	—	5	4168,4174,5910	1
795	H 2640	Scorpius	b	21469	45.0	−25 27	4.79	B 3 A	—	2	9654,9655	2
796	S 5416	Triang. Aust.	β	21484	46.4	−63 7	3.09	F	—	4	4219,5875,7559	2
797	H 2651	Scorpius	A	21521	47.6	−25 2	4.74	B 3 A	—	2	9654,9655	2
798	S 5450	Lupus	ξ	21586	50.5	−33 40	5.08	A	131	3	6671,8812,8818	1
799	S 5451	Lupus	—	21587	50.5	−33 40		A	131	3	6671,8812,8818	1
800	H 2662	Scorpius	ρ	21592	50.7	−28 55	4.01	B 3 A	55	2	4834,5678	1

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801	S 5464	Lupus	—	21630	15	52.7	−41	27	4.87	G 5 K	—	2	9127,9255	1
802	H 2671	Scorpius	π	21638		52.8	−25	49	3.08	B 2 A Pec.	46	56	4221,5657,7822	2
803	S 5469	Lupus	η	*21653*		53.4	−38	6	3.77	B 3 A	18,51	19	4220,5899,6307	2
804	H 2674	Scorpius	δ	21685		54.4	−22	20	2.52	B	18,21	11	4338,5708,6441	2
805	S 5486	Norma	ι^1	21694		55.4	−57	29	4.82	A 2 F	18	8	9108,9270,9386	1
806	S 5489	Norma	η	21710		55.8	−48	57	4.66	G 5 K	—	6	4739,5571,5631	1
807	S 5496	Lupus	—	21728		56.8	−38	19	5.10	B 5 A	—	2	5899,6307	1
808	—	Lupus	—	*21767*		58.0	−37	35	R	F	170	3	4777,5863,6307	1
809	S 5510	Norma	δ	21792		59.5	−44	54	4.78	A 3 F Pec.	163	3	4823,5912,6343	1
810	H *2690*	Scorpius	β	*21805*		59.6	−19	32	R	B 1 A	35	1	5921	1
811	S 5512	Lupus	θ	21810	16	0.0	−36	32	4.42	B 3 A	—	3	4777,5863,6596	1
812	—	Lupus	—	21828		0.7	−36	29	R	F	—	3	4777,5863,6596	1
813	H 2698	Scorpius	ω^1	21841		1.0	−20	24	4.10	B 2 A	—	5	4832,5921,5929	1
814	S 5516	Norma	ι^2	21827		1.0	−57	40	5.84	A	133	2	9108,9270	1
815	H 2700	Scorpius	ω^2	21849		1.6	−20	36	4.57	G	190	5	4832,5921,5929	1
816	S 5549	Apus	δ^1	21881		5.3	−78	27	4.73	Mb	204	20	4175,4758,4807	2
817	S 5551	Apus	δ^2	21886		5.5	−78	25	5.19	K 5 M	204	20	4175,4758,4807	2
818	S 5555	Triang. Aust.	δ	21939		6.4	−63	26	4.04	G	—	3	4885,5606,6615	1
819	S 5578	Norma	γ^1	22012		9.6	−49	49	4.95	F 8 G	184	3	4789,5888,6531	1
820	S 5593	Norma	γ^2	22075		12.4	−49	55	4 19	K	—	3	4789,5888,6531	1
821	H 2737	Scorpius	o	22146		14.6	−23	56	4.70	A 3 F	—	7	4722,5616,6363	1
822	S 5609	Norma	—	22147		15.0	−49	20	5.40	B 5 A	—	3	4789,5888,6531	1
823	H 2738	Scorpius	σ	22158		15.1	−25	21	2.99	B 1 A	30	9	4339,5093,5119	2
824	—	Triang. Aust.	—	22165		16.3	−62	54	R	A 2 F	133	1	6615	1
825	S 5625	Triang. Aust.	ζ	22185		17.6	−69	52	4.99	G	—	11	9090,9391,9410	1
826	S 5631	Apus	γ	22170		18.1	−78	41	3.94	K	199	18	4175,5102,5110	2
827	S *5641*	Norma	ε	*22246*		19.8	−47	20	R	B 5 A	87	6	4750,5572,6373	1
828	S 5648	Norma	—	22297		22.5	−46	2	5.38	B 1 A Pec.	42	9	6626,9452,9474	1
829	H 2764	Scorpius	α	22314		23.2	−26	13	1.06	Ma Comp.	212	16	4093,5730,6588	3
830	S 5655	Apus	—	22293		23.3	−70	47	5.53	K	68	1	9735	1
831	S 5667	Scorpius	N	22347		24.8	−34	29	4.46	B 8 A	—	6	4797,5015,5070	1
832	H 2775	Ophiuchus	ω	22374		26.2	−21	15	4.66	F	167	3	4819,4840,5913	1
833	S 5690	Apus	β	22393		28.8	−77	18	4.22	K	—	4	4873,5111,5153	1
834	H 2783	Scorpius	τ	22451		29.7	−28	0	2.90	B	22	6	4362,5837,7612	2
835	S 5703	Scorpius	H	22454		29.8	−35	3	4.08	Ma	—	8	4796,5015,5070	1
836	S 5751	Ara	—	22613		37.8	−58	19	5.89	B 3 A	—	5	4170,4851,5699	2
837	S 5752	Triang. Aust.	α	22607		38.0	−68	51	1.89	K 2 M	—	9	4169,5793,5794	2
838	S 5755	Ara	—	22626		38.8	−58	9	5.74	B	20	5	4170,4851,5699	2
839	S 5767	Ara	η	22672		41.1	−58	52	3.60	K 5 M	—	8	4170,4851,5699	2
840	S 5787	Scorpius	ε	22731		43.7	−34	7	2.29	K	—	8	4190,5658,7550	3
841	S 5793	Scorpius	—	22748		44.5	−41	4	5.48	Oe	12	7	4985,5058,6325	2
842	S 5794	Scorpius	μ^1	22761		45.1	−37	53	3.26	B 3 A Pec.	73	91	4382,5710,5776	3
843	S 5798	Scorpius	—	22763		45.3	−41	41	6.78	Oc	—	9	4400,4985,5058	2
844	S 5800	Scorpius	μ^2	22778		45.6	−37	51	3.74	B 2 A	—	90	4382,5710,5776	3
845	S 5809	Scorpius	ζ^1	22812		47.0	−42	12	4.96	*B 1 A* Pec.	40,43	12	4400,4985,5058	2
846	—	Scorpius	—	22814		47.0	−41	39	R	B	26,27	8	4400,4985,5058	2
847	—	Scorpius	—	*22824*		47.1	−41	41	R	B	28	2	5058,6463	1
848	S 5812	Scorpius	—	22827		47.3	−41	40	6.95	Oa	—	12	4400,4985,5058	2
849	—	Scorpius	—	22829		47.4	−42	19	R	F 5 G	—	2	4985,5058	1
850	S 5815	Scorpius	ζ^2	22832		47.6	−42	12	3.53	K 5 M	—	12	4400,4985,5058	2

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851	S 5821	Scorpius	—	22843	16 48.0	−41 0	6.11	Oe	13	8	4985,5058,6463	2
852	—	Scorpius	—	22845	48.1	−41 56	R	B	29	1	5058	1
853	S 5837	Ara	ζ	22916	50.4	−55 50	3.02	K 5 M	—	7	4363,4886,5738	2
854	S 5844	Ara	ϵ^1	22941	51.6	−53 0	4.17	K 2 M	—	11	4176,4177,5029	1
855	—	Ara	—	22949	52.0	−54 26	R	A 2 F	68	2	6755,6756	1
856	S 5872	Ara	ϵ^2	23018	55.2	−53 5	5.39	F 8 G	—	11	4176,4177,5029	1
857	S 5898	Scorpius	k	23098	58.2	−33 59	4.98	B 1 A Pec.	42	9	9109,9324,9411	1
858	S 5924	Scorpius	—	23206	17 3.5	−44 26	4.93	G 5 K	—	2	9116,9262	1
859	S 5930	Scorpius	η	23250	5.0	−43 6	3.37	F 2 G	—	10	4419,4874,5763	2
860	S 5980	Apus	ζ	23378	11.5	−67 40	4.70	K 2 M	—	7	9128,9428,9593	1
861	—	Ara	—	23459	14.7	−56 26	R	K	—	4	4862,4887,6657	1
862	H 2895	Ophiuchus	ξ	23481	15.0	−21 1	4.51	F 5 G	—	3	4824,5636,5645	1
863	—	Ara	—	23472	15.2	−60 35	R	B 8 A	—	2	5052,5608	1
864	H 2899	Ophiuchus	θ	23500	15.8	−24 54	3.44	B 3 A	—	7	4401,5722,6589	2
865	S 6019	Scorpius	—	23522	17.0	−44 4	4.98	B 8 A	—	7	9263,9416,9606	1
866	S 6020	Ara	β	23516	17.0	−55 27	2.72	K 2 M	—	38	4408,4420,4862	2
867	S 6021	Ara	γ	23515	17.0	−56 17	3.42	B 1 A	18,33	38	4408,4420,4862	2
868	—	Ophiuchus	—	23577	18.7	−21 21	R	K	—	1	5645	1
869	—	Ophiuchus	—	23589	19.1	−29 35	R	A 2 F	133	2	4999,6857	1
870	H 2909	Ophiuchus	b	23614	20.2	−24 6	4.47	F	168	4	4740,5820,6606	1
871	S 6044	Ara	—	23603	20.4	−55 6	5.97	K	—	2	4887,6849	1
872	H 2916	Ophiuchus	d	23629	21.0	−29 47	4.38	F 5 G	—	7	4898,4999,5632	2
873	—	Ophiuchus	—	23633	21.3	−29 39	R	B 9 A	—	4	4898,4999,5632	1
874	S 6056	Ara	δ	23636	22.1	−60 37	3.76	B 8 A	18	9	4435,5052,5608	2
875	—	Ara	—	23656	22.9	−56 50	R	B 8 A	—	3	4408,6504,6849	1
876	S 6063	Scorpius	υ	23698	24.0	−37 13	2.84	B 3 A	—	15	4364,5195,5196	3
877	S 6064	Ara	α	23694	24.1	−49 47	2.86	*B 3 A*	18,75	49	4901,5059,5795	2
878	H 2927	Ophiuchus	c	23739	25.3	−23 53	4.88	A	—	7	4820,4841,5617	1
879	S 6082	Scorpius	λ	23778	26.8	−37 2	1.79	B 2 A	18	15	4364,5195,5196	3
880	S 6093	Ara	σ	23805	28.3	−46 26	4.54	A	—	7	9325,9429,9594	1
881	S 6099	Scorpius	Q	23841	29.6	−38 34	4.19	K	—	5	4778,5668,6547	1
882	S 6100	Ara	—	23835	29.7	−49 59	5.78	K	—	1	9322	1
883	S 6104	Scorpius	θ	23849	30.1	−42 56	1.99	F	—	7	4439,5731,7551	2
884	S 6124	Ara	λ	23888	32.6	−49 21	4.85	F 5 G	68	5	9322,9567,9639	1
885	S 6154	Scorpius	κ	23966	35.5	−38 59	2.59	B 2 A	18	5	4402,5754,7605	2
886	S 6155	Pavo	η	23958	35.9	−64 41	3.51	K	—	7	4461,4902,5777	2
887	S 6191	Scorpius	ι^1	24107	40.5	−40 6	3.10	F 5 G Pec.	40,182	4	4421,5778,7657	2
888	H 2972	Sagittarius	X	24120	41.3	−27 48	4.87	F 8 G	184	1	7057	1
889	—	Sagittarius	—	24156	42.2	−26 57	R	B 3 A	—	1′	7057	1
890	S 6202	Scorpius	—	24169	42.7	−31 40	4.95	B 8 A	—	9	9129,9440,9453	1
891	S 6204	Scorpius	G	24179	43.0	−37 1	3.22	K 2 M	—	8	4409,4903,5779	2
892	S 6205	Scorpius	ι^2	24182	43.1	−40 4	4.89	A 2 F Pec.	40,156	2	4421,5778	1
893	—	Scorpius	—	24218	44.6	−40 45	R	Ma	—	1	4421	1
894	S 6264	Scorpius	—	24321	49.5	−44 19	4.87	K	—	8	9110,9438,9461	1
895	S 6276	Scorpius	—	24348	50.7	−41 42	4.71	Ma	—	5	9100,9256,9333	1
896	H 3035	Sagittarius	W	24577	58.6	−29 35	4.88	F 5 G	—	3	5739,5909,9200	2
897	S 6338	Ara	θ	24574	58.8	−50 6	3.84	B 1 A	39,40	6	4008,5715,7599	2
898	S 6339	Pavo	π	24559	58.9	−63 40	4.39	A 5 F	—	3	4741,4986,5701	1
899	S 6341	Sagittarius	γ	24596	59.4	−30 25	3.02	K	—	6	4403,5739,5909	2
900	—	Ara	—	24630	18 1.1	−45 47	R	B 8 A	106	5	4723,4852,5071	1

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901	H 3039	Sagittarius	—	24649	18 1.8	−28 28	4.69	K	—	1	6795	1
902	—	Telescopium	—	24650	2.1	−45 57	R	F 8 G	68	1	5071	1
903	S 6370	Sagittarius	—	R	2.5	−21 16	7.80	Oa	—	1	4096	1
904	S 6374	Telescopium	ε	24703	3.9	−45 58	4.54	K	199	12	4723,4852,4875	2
905	S 6400	Pavo	—	24745	6.2	−63 5	5.62	K	—	2	4986,5701	1
906	—	Telescopium	—	24765	6.4	−46 20	R	A	—	1	6702	1
907	H 3062	Sagittarius	μ	24812	7.8	−21 5	4.08	B 8 A Pec.	40,113	6	4904,5103,5122	2
908	S 6412	Corona Aust.	—	24818	8.6	−44 14	5.37	K	—	1	6646	1
909	—	Sagittarius	—	*24839*	9.1	−36 37	R	B 3 A	67	3	7072,8823,8827	1
910	H 3068	Sagittarius	—	24854	9.3	−20 25	6.17	B 1 A	—	2	5103,5930	1
911	H 3069	Sagittarius	—	24850	9.3	−20 46	5.60	B	—	2	5103,5930	1
912	—	Pavo	—	24848	10.0	−63 55	R	G	132	2	4986,5701	1
913	S 6428	Sagittarius	η	24888	10.9	−36 48	2.96	Mb	—	16	4365,5030,5085	2
914	—	Sagittarius	—	24897	11.1	−28 19	R	F 8 G	—	2	7103,7137	1
915	H 3076	Sagittarius	—	24919	11.8	−27 5	4.71	K 5 M	206	11	4751,5043,5086	1
916	—	Telescopium	—	24925	12.4	−45 44	R	F 8 G	—	1	6702	1
917	S 6442	Pavo	ξ	24958	14.0	−61 33	4.15	K 2 M	—	9	4889,4906,5120	1
918	H 3084	Sagittarius	δ	24987	14.6	−29 53	2.83	K	—	8	4178,5163,5807	2
919	S 6458	Sagittarius	—	25020	16.1	−36 44	5.55	B 8 A	—	5	4365,5030,5112	1
920	S 6465	Sagittarius	—	25037	16.7	−36 18	5.55	K	—	2	4365,8823	1
921	S 6466	Telescopium	—	25032	16.8	−49 42	6.64	F 8 G	—	2	6961,7092	1
922	S 6471	Sagittarius	ε	25060	17.6	−34 25	1.93	A	18	9	4410,5206,5740	3
923	H 3105	Sagittarius	—	25108	19.4	−20 35	4.87	G 5 K	198	12	4724,4798,4825	1
924	S 6484	Telescopium	α	25105	19.6	−46 1	3.69	B 3 A	—	7	4440,5755,6454	2
925	S 6491	Telescopium	ζ	25140	21.1	−49 7	4.00	K	—	4	4877,5732,6961	1
926	—	Sagittarius	—	25160	21.5	−26 41	R	A 5 F	133	1	6914	1
927	H 3111	Sagittarius	λ	25171	21.8	−25 28	3.06	K	—	11	4404,5723,7570	2
928	—	Sagittarius	—	25172	21.9	−26 49	R	A 3 F	—	1	6914	1
929	S 6499	Pavo	ν	25153	22.0	−62 20	4.85	B 8 A	—	5	4863,4889,5673	1
930	—	Sagittarius	—	25182	22.1	−17 51	R	B 8 A	—	1	7451	1
931	—	Sagittarius	—	*25197*	22.8	−26 38	R	A	133,231	1	6914	1
932	—	Corona Aust.	—	25233	24.0	−41 59	R	A 5 F	—	3	4858,5586,7118	1
933	H 3121	Sagittarius	—	25257	24.8	−18 47	5.73	K	—	1	7451	1
934	S 6510	Telescopium	δ^1	25243	24.4	−45 59	5.06	B 8 A	—	6	4440,5755,6454	2
935	S 6513	Telescopium	δ^2	25255	24.7	−45 49	5.30	B 5 A	—	6	4440,5755,6454	2
936	S 6523	Corona Aust.	θ	25297	26.4	−42 23	4.41	G 5 K	—	4	4853,5586,5922	1
937	S 6557	Pavo	ζ	25383	31.3	−71 31	4.04	K	—	7	4462,4936,4937	1
938	H 3147	Lyra	α	—	33.6	+38 41	0.19	A	—	4	4094,7890,7905	3
939	S 6566	Pavo	—	25454	33.8	−64 39	5.83	K	—	2	9117,9264	1
940	S 6572	Pavo	—	25500	35.7	−64 58	4.76	A 2 F	—	6	9117,9264,9336	1
941	—	Sagittarius	—	25560	37.4	−36 49	R	K	—	3	6694,6858,7068	1
942	S 6584	Sagittarius	—	25565	37.6	−35 45	4.91	B 3 A	—	7	4769,4779,5624	1
943	—	Sagittarius	—	25587	38.6	−35 58	R	K	—	2	6694,6858	1
944	S 6594	Pavo	θ	25574	38.8	−65 11	5.93	A 3 F	—	2	9117,9264	1
945	H 3157	Sagittarius	φ	25614	39.4	−27 6	3.33	B 8 A	—	6	4411,4907,5785	2
946	S 6617	Pavo	λ	25692	42.9	−62 18	4.35	B 2 A	18	3	4821,5031,5637	1
947	S 6640	Pavo	κ	25786	46.6	−67 21	var.	F 5 G	180	6	6532,6985,7768	2
948	H 3196	Sagittarius	ν^1	25853	48.1	−22 52	5.02	G 5 K	196,197	16	4752,4759,4994	1
949	H 3200	Sagittarius	ν^2	25876	49.1	−22 47	5.15	K	—	16	4752,4759,4994	1
950	H 3199	Sagittarius	σ	25874	49.1	−26 25	2.30	B 3 A	18	16	4405,4406,5060	3

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951	H 3203	Sagittarius	—	25895	18	49.9	−23	18	5.94	B 8 A	—	4	4759,4994,6796	1
952	S 6653	Corona Aust.	—	25886		49.9	−37	28	5.54	B 5 A	—	3	9111,9323,9771	1
953	—	Pavo	—	25869		50.0	−66	47	R	K	165	2	6532,7768	2
954	S 6656	Telescopium	λ	25897		50.5	−53	4	4.86	B 9 A	119	5	4864,5756,6674	1
955	H 3213	Sagittarius	ξ^1	25919		51.4	−20	47	4.97	A	125	8	4422,4899,4987	2
956	H 3218	Sagittarius	ξ^2	25927		51.8	−21	14	3.53	K	—	9	4422,4899,4987	2
957	S 6661	Corona Aust.	ε	25928		52.0	−37	14	4.91	F 5 G	—	6	8740,9111,9323	2
958	—	Sagittarius	—	25944		52.4	−22	40	R	A 2 F	—	4	4759,5104,6796	1
959	—	Corona Aust.	—	26000		55.1	−42	3	R	A	—	3	5733,5931,6318	1
960	S 6683	Corona Aust.	ζ	26027		56.1	−42	14	4.76	A	—	5	4799,5733,5931	1
961	S 6686	Sagittarius	ζ	26041		56.3	−30	1	2.69	A 2 F	—	6	4436,5001,5587	2
962	S 6693	Sagittarius	—	26084		58.0	−31	12	5.65	A	—	1	7582	1
963	H 3252	Sagittarius	ο	26102		58.7	−21	53	3.91	K	—	11	4956,5890,6540	2
964	—	Corona Aust.	—	26119		59.6	−42	58	R	K	—	1	7129	1
965	S 6705	Corona Aust.	γ	26123		59.7	−37	12	4.28	F 8 G	—	5	4780,4957,5724	2
966	—	Corona Aust.	—	26134	19	0.1	−37	57	R	G 5 K	165	1	5724	1
967	H 3258	Sagittarius	τ	26149		0.7	−27	49	3.48	K	—	10	4457,4908,5787	2
968	S 6716	Corona Aust.	δ	26162		1.3	−40	39	4.41	K	—	4	4742,4854,5647	1
969	S 6727	Corona Aust.	α	26189		2.7	−38	4	4.22	A 2 F	—	5	4957,5017,5690	2
970	S 6728	Corona Aust.	—	26191		2.7	−39	59	6.38	K	165	4	5017,5647,5914	1
971	S 6731	Corona Aust.	—	26198		3.0	−42	3	5.92	B 5 A	—	2	5914,6318	1
972	S 6732	Corona Aust.	β	26206		3.1	−39	30	3.99	G 5 K	—	8	4966,5017,5690	2
973	H 3270	Sagittarius	π	26225		3.8	−21	11	3.11	F 2 G	—	10	4009,4423,5164	2
974	—	Sagittarius	—	26229		4.2	−39	10	R	B 8 A	111	2	5690,7096	1
975	S *6797*	Sagittarius	β^1	*26485*		15.4	−44	38	R	B 8 A	103	11	4437,4760,5032	2
976	S 6803	Sagittarius	β^2	26500		16.0	−44	59	4.35	F	—	11	4437,4760,5032	2
977	S 6805	Sagittarius	α	26527		16.9	−40	48	4.13	B 8 A	—	10	4441,5072,5766	2
978	—	Sagittarius	—	26532		17.2	−43	55	R	Ma	—	1	7093	1
979	—	Sagittarius	—	26557		17.8	−44	23	R	K	—	1	7093	1
980	S 6857	Telescopium	ι	26780		27.8	−48	19	4.95	K	—	12	9257,9321,9393	1
981	H 3370	Sagittarius	h^1	26827		29.9	−24	56	5.82	A 3 F	162	6	4958,5878,6647	1
982	H 3373	Sagittarius	h^2	26843		30.6	−25	6	4.64	B 9 A	120	6	4958,5878,6647	1
983	S 6908	Sagittarius	—	26977		36.3	−25	6	6.55	A 5 F	133	1	6822	1
984	S 6916	Pavo	—	26980		37.9	−72	45	5.49	A 3 F	—	1	5797	1
985	H 3414	Sagittarius	f	27075		40.6	−20	0	5.06	K	—	8	4826,4988,5648	1
986	S 6929	Pavo	—	27100		42.2	−59	26	5.54	A 2 F	—	3	9632,9661,9888	1
987	H 3429	Aquila	α	—		45.9	+ 8	36	0.97	A 5 F	18	4	4097,7907,8083	3
988	S 6952	Sagittarius	ι	27239		48.3	−42	8	4.08	K	—	4	4770,4967,5285	1
989	S 6954	Pavo	—	27237		48.7	−59	10	5.31	A	—	6	9118,9632,9661	1
990	S 6957	Pavo	ε	27225		49.0	−73	10	4.04	A	125	10	4397,5198,5797	2
991	H 3446	Sagittarius	ω	27272		49.7	−26	34	4.95	G 5 K	195	15	4753,4781,5002	1
992	S 6966	Pavo	μ^1	27273		50.7	−67	13	5.70	K	—	1	7769	2
993	H 3451	Sagittarius	b	27289		50.8	−27	26	4.72	K 2 M	—	16	4753,4781,5002	1
994	—	Sagittarius	—	27292		51.0	−38	19	R	F 5 G	—	2	5073,7125	1
995	S 6969	Pavo	μ^2	27298		52.2	−67	13	5.20	K	—	1	7769	2
996	H 3459	Sagittarius	A	27332		52.8	−26	28	5.03	G 5 K	—	16	4753,4781,5002	1
997	S 6975	Sagittarius	θ^1	27344		53.2	−35	33	4.68	B 3 A	—	2	4843,5594	1
998	S 6976	Sagittarius	θ^2	27346		53.3	−34	58	5.38	A 3 F	—	2	4843,5594	1
999	S 6979	Pavo	—	27330		53.3	−59	39	4.87	Mb	—	2	9118,9888	1
1000	S 6981	Sagittarius	—	27354		53.7	−37	58	5.98	K	—	6	5073,5915,6823	1

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1001	—	Pavo	—	27380	19 55.5	−67 35	R	G 5 K	68	1	7769	2
1002	H 3477	Sagittarius	c	27430	56.5	−27 59	4.69	Mb	—	11	4844,4938,5105	1
1003	S 6994	Sagittarius	—	27440	56.9	−38 13	4.68	K 5 M	—	12	4909,4968,4980	1
1004	—	Sagittarius	—	27438	56.9	−39 8	R	F	172	2	5915,7125	1
1005	—	Sagittarius	—	27442	57.0	−37 48	R	K	—	3	5073,6823,7125	1
1006	—	Sagittarius	—	27452	57.4	−38 9	R	G	—	6	5073,5915,6823	1
1007	S 7006	Pavo	δ	27468	58.9	−66 26	3.56	G 5 K	—	7	4396,4995,5767	2
1008	S 7009	Telescopium	ξ	27496	59.7	−53 10	4.82	Ma	—	15	9258,9413,9454	1
1009	S 7074	Pavo	α	27918	20 17.7	−57 3	2.05	B 3 A	—	25	4010,5199,5268	3
1010	S 7113	Pavo	ϕ^1	28140	27.3	−60 55	4.73	F	—	4	4865,4878,5675	1
1011	S 7121	Pavo	ρ	28179	29.2	−61 52	5.02	F 5 G	—	5	4865,4878,5675	1
1012	S 7126	Indus	α	28213	30.6	−47 39	3.20	K	199	12	4442,4472,5165	2
1013	S 7134	Pavo	ϕ^2	28236	31.8	−60 53	5.24	F 8 G	—	4	4865,4878,5675	1
1014	S 7137	Pavo	υ	28259	32.8	−67 7	5.32	B 9 A	—	7	4180,5891,6986	2
1015	S 7150	Pavo	β	28338	36.0	−66 34	3.54	A 5 F	—	13	4180,5380,5891	2
1016	S 7152	Indus	η	28363	36.7	−52 17	4.73	F	—	2	4866,5691	1
1017	H 3631	Cygnus	α	—	38.0	+44 56	1.47	A 2 F Pec.	40,154	2	4098,7990	2
1018	H 3638	Capricornus	ψ	28455	40.2	−25 38	4.33	F 8 G	183	5	4761,5201,5269	1
1019	—	Capricornus	—	28516	42.5	−19 38	R	F 5 G	—	1	7126	1
1020	S 7168	Indus	ζ	28510	42.6	−46 36	4.90	K 5 M	—	5	9259,9318,9751	1
1021	H 3652	Capricornus	—	28539	43.4	−26 9	5.73	B 8 A	68	5	4761,4989,5810	1
1022	S 7171	Microscopium	α	28544	43.8	−34 9	4.98	K	199	8	4800,5588,6808	1
1023	—	Capricornus	—	28557	44.1	−27 45	R	K	—	1	6797	1
1024	—	Capricornus	—	28593	45.6	−27 37	R	F 8 G	68	4	4989,5719,6797	1
1025	—	Microscopium	—	28595	45.6	−28 22	R	A 3 F	161	1	6797	1
1026	S 7181	Microscopium	β	28597	45.8	−33 33	6.20	A 2 F	—	6	4800,5588,6808	1
1027	H 3661	Capricornus	ω	28598	45.9	−27 17	4.43	Ma	—	11	4292,4387,4939	1
1028	S 7191	Indus	β	28615	47.0	−58 49	3.66	K	—	20	4329,4358,4398	2
1029	—	Capricornus	—	28648	47.8	−19 29	R	K	—	1	7126	1
1030	—	Capricornus	—	28651	48.0	−26 41	R	F 5 G	177	1	6797	1
1031	—	Microscopium	—	28656	48.1	−28 18	R	Mb	—	1	6797	1
1032	H 3678	Capricornus	—	28702	50.9	−26 40	5.92	F 8 G	—	1	4387	1
1033	S 7225	Microscopium	γ	28782	55.1	−32 39	4.75	G 5 K	—	1	4919	1
1034	H 3706	Capricornus	η	28879	58.7	−20 15	5.17	A 3 F	—	7	4927,5924,6809	1
1035	S 7241	Microscopium	—	28918	21 0.3	−32 44	5.15	K	—	2	4919,6893	1
1036	H 3715	Capricornus	A	28951	1.3	−25 24	4.63	Ma	—	15	4782,4981,4996	1
1037	S 7277	Indus	—	29117	8.6	−53 41	5.80	A 5 F	—	3	5725,5903,7148	1
1038	S 7286	Microscopium	ε	29200	11.9	−32 36	4.84	A	125	8	4947,5681,5940	2
1039	S 7293	Indus	θ	*29216*	12.7	−53 52	4.56	A 5 F	227	5	4867,5725,5903	2
1040	S 7304	Microscopium	θ^1	29248	14.4	−41 14	5.01	A 2 F Pec.	158	8	4959,5383,5384	1
1041	S 7319	Microscopium	θ^2	29314	18.0	−41 26	5.87	A Pec.	147	8	4959,5383,5384	1
1042	S 7320	Pavo	γ	29309	18.2	−65 50	4.17	F 8 G	—	3	4879,5768,7081	1
1043	H 3779	Capricornus	ζ	29382	20.9	−22 51	3.79	G Pec.	193	23	4293,4297,4940	2
1044	H 3783	Capricornus	b	29426	23.0	−22 15	4.46	G 5 K	—	18	4293,4297,4940	2
1045	H 3802	Capricornus	—	29544	29.2	−20 31	5.87	F 5 G	—	5	5692,7131,7157	1
1046	S 7366	Octans	ν	29533	30.4	−77 50	3.73	K	—	16	4344,4359,4463	2
1047	H 3809	Capricornus	ε	29598	31.5	−19 54	4.53	B 5 A Pec.	95	16	4845,5692,7131	1
1048	H 3827	Capricornus	—	29717	37.6	−20 4	6.25	A 3 F	162	1	7131	1
1049	S 7403	Piscis Aust.	ι	29737	39.0	−33 29	4.41	A	18,130	6	4970,5004,5653	1
1050	S 7411	Piscis Aust.	θ	29795	41.9	−31 22	5.25	A 2 F	—	10	4910,5088,5208	2

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1051	S 7432	Grus	γ	29935	21	47.9	−37	50	3.20	B 8 A	—	17	4294,5381,5440	2
1052	S 7448	Indus	δ	29999		51.1	−55	28	4.51	F	—	7	4960,5068,5079	1
1053	—	Indus	—	30057		53.6	−56	22	R	B 8 A	—	2	4920,5113	1
1054	S 7463	Indus	ε	30105		55.7	−57	11	4.79	K 5 M	—	5	4920,5113,5682	1
1055	—	Indus	—	30133		56.9	−56	28	R	G	—	2	4920,5113	1
1056	S 7474	Grus	λ	30209	22	0.1	−40	2	4.52	K 2 M	—	7	4948,5640,5799	1
1057	S 7481	Grus	α	30241		1.9	−47	27	1.92	B 5 A	18,86	26	4181,5273,5757	3
1058	S 7486	Piscis Aust.	μ	30260		2.6	−33	29	4.64	A 2 F	149	6	4928,5385,5811	1
1059	S 7487	Piscis Aust.	υ	30261		2.6	−34	32	4.97	K 5 M	—	3	4928,6879,7127	1
1060	—	Piscis Aust.	—	30268		2.9	−33	37	R	A 2 F	—	1	7127	1
1061	S 7490	Piscis Aust.	—	30290		4.1	−34	31	5.51	A 5 F	132	3	4928,6879,7127	1
1062	S 7491	Piscis Aust.	τ	30294		4.3	−33	3	4.95	F 8 G	—	5	4928,5811,6879	1
1063	—	Grus	—	30378		8.5	−41	51	R	G	—	5	5005,5089,6894	1
1064	S 7509	Grus	μ^1	30395		9.6	−41	51	4.86	G	—	6	4911,5005,5089	1
1065	S 7517	Grus	μ^2	30405		10.4	−42	8	5.16	G 5 K	—	6	4911,5005,5089	1
1066	S 7524	Tucana	α	30422		11.6	−60	46	2.90	K 2 M	—	17	4295,4783,4990	2
1067	S 7525	Grus	—	30425		11.7	−54	7	5.44	G	—	1	5207	1
1068	S 7533	Tucana	—	30468		14.0	−58	1	6.31	K 5 M	68	1	6819	1
1069	S 7543	Tucana	—	30557		18.3	−58	17	5.40	G 5 K	—	1	6819	1
1070	S 7550	Tucana	δ	30594		20.2	−65	28	4.74	B 9 A	—	4	4982,5390,5702	1
1071	—	Tucana	—	30604		20.8	−58	30	R	A 2 F	68	1	6819	1
1072	S 7563	Grus	δ^1	30647		23.3	−44	0	4.07	G 5 K	—	7	4345,4971,5053	1
1073	S 7564	Grus	δ^2	30657		23.8	−44	15	4.26	Mb	—	7	4345,4971,5053	1
1074	S 7572	Piscis Aust.	β	*30704*		25.8	−32	51	4.48	A	228	5	4983,5687,5881	1
1075	S 7573	Tucana	ν	30709		26.2	−62	29	4.80	Mb	—	6	9130,9319,9329	1
1076	—	Piscis Aust.	—	30762		28.4	−32	39	R	B 8 A	68	2	6683,7149	1
1077	S 7588	Grus	—	30805		30.7	−41	6	6.12	A 2 F	133	1	5790	1
1078	S 7589	Piscis Aust.	—	30810		31.0	−32	11	5.48	K	132	1	6683	1
1079	S 7590	Grus	—	30814		31.2	−41	6	5.65	A 2 F	68	1	5790	1
1080	—	Grus	—	30830		32.0	−40	22	R	F 8 G	132	1	5790	1
1081	H 4007	Piscis Aust.	ε	30889		35.1	−27	34	4.06	B 8 A	—	2	4880,5831	1
1082	S 7612	Octans	β	30879		35.9	−81	54	4.35	F	—	8	4972,5125,5136	1
1083	S 7615	Grus	β	30913		36.7	−47	24	2.09	Mb	213	17	4182,4296,5650	3
1084	S 7619	Grus	ρ	30930		37.7	−41	56	4.83	K	—	8	5021,5081,5683	1
1085	S 7627	Grus	η	30968		39.5	−54	1	4.87	K	—	15	4921,5075,5098	1
1086	—	Grus	—	31012		41.4	−42	13	R	K	68	1	7107	1
1087	S 7645	Grus	ε	31044		42.5	−51	50	3.69	A 2 F	—	7	4360,5382,5832	2
1088	—	Piscis Aust.	—	31083		44.4	−33	20	R	A 5 F	—	1	7158	1
1089	S 7668	Piscis Aust.	γ	31123		47.0	−33	24	4.63	A	—	10	4929,5126,5703	1
1090	S 7680	Piscis Aust.	δ	31184		50.4	−33	4	4.08	K	199	10	4929,4941,5126	1
1091	S 7684	Piscis Aust.	α	31213		52.1	−30	9	1.27	A 3 F	160	34	4183,4297,5726	3
1092	S 7693	Grus	ζ	31263		55.0	−53	17	4.13	G 5 K	—	12	4330,4483,5144	2
1093	S 7715	Grus	θ	31380	23	1.2	−44	4	4.40	F 5 G	—	11	4346,5215,5275	1
1094	H 4083	Aquarius	c^1	31385		1.3	−24	17	4.82	G 5 K	—	3	4949,5693,7159	1
1095	H 4093	Aquarius	c^2	31431		4.1	−21	43	3.55	K	—	13	4361,4961,5744	2
1096	S 7730	Grus	—	31437		4.4	−43	24	5.89	F 8 G	—	5	4346,5215,5275	1
1097	H 4096	Aquarius	c^3	31442		4.5	−23	00	4.89	G Comp.	194	9	4961,5138,4744	2
1098	S 7734	Grus	ι	31445		4.7	−45	47	4.06	K	199	14	4443,4460,5391	2
1099	S 7758	Tucana	γ	31563		11.6	−58	47	3.98	F 2 G	—	13	5392,5866,5987	2
1100	S 7764	Sculptor	γ	31591		13.5	−33	5	4.34	K	—	7	5082,5145,5852	1

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1101	H 4139	Aquarius	b¹	31676	23 17.7	−20 39	4.12	K	—	10	4331,5034,5694	2
1102	H 4145	Aquarius	b²	31734	20.8	−21 12	4.36	K 5 M	—	9	4331,5034,5694	2
1103	S 7807	Phœnix	—	31826	26.0	−45 24	5.83	K	—	2	5076,6862	1
1104	—	Phœnix	—	31853	27.3	−45 41	R	A 2 F	133	1	6862	1
1105	S 7815	Sculptor	β	31859	27.6	−38 23	4.58	B 9 A	—	7	5091,5175,5216	1
1106	H 4157	Aquarius	b³	31869	28.0	−21 28	4.73	A	18	4	5083,5090,5833	1
1107	S 7816	Phœnix	ι	31906	29.7	−43 10	4.87	A 2 F Pec.	159	13	4912,5022,5127	1
1108	—	Phœnix	—	31934	31.2	−45 27	R	A 5 F	133	2	5076,6862	1
1109	S 7823	Phœnix	—	31955	32.5	−46 3	4.92	A 2 F	—	8	5076,5386,5813	1
1110	—	Phœnix	—	31975	33.6	−46 10	R	A 5 F	133	1	6862	1
1111	S 7857	Phœnix	σ	32130	41.9	−50 47	5.35	B 5 A	—	5	5006,5114,5783	1
1112	H 4205	Sculptor	δ	32161	43.7	−28 41	4.56	A	—	4	5055,5387,5905	1
1113	—	Tucana	—	32240	48.4	−66 31	R	F 8 G	—	3	5393,5906,7084	1
1114	S 7893	Tucana	η	32311	52.3	−64 52	5.12	A 2 F	—	6	5054,5133,5814	1
1115	—	Tucana	—	32324	53.1	−63 34	R	A 2 F	133	1	5814	1
1116	S 7901	Phœnix	π	32333	53.7	−53 19	5.12	K	—	12	5035,5146,5174	1
1117	S 7902	Sculptor	—	32337	54.3	−30 3	5.62	K 5 M	—	6	5765,6826,6888	1
1118	S 7904	Tucana	ε	32347	54.7	−66 8	4.64	B 9 A	—	4	4855,5393,5906	1
1119	—	Phœnix	—	32359	55.4	−53 40	R	G	—	2	5825,7133	1
1120	S 7910	Octans	θ	32376	56.4	−77 37	4.62	K	—	3	9265,9331,9890	1
1121	S 7913	Sculptor	ζ	32389	57.2	−30 17	4.93	B 5 A	—	11	4950,5394,5895	1
1122	S 7919	Sculptor	—	*32414*	59.2	−29 50	6.61	A 2 F	133,151	3	6922,7108,7307	1

REMARKS.

23. In H. P., — Ceti.
47. In H. P., — Ceti.
53. In H P., — Ceti.
56. A. G. C. magn. 7.1.
64. A. G. C. magn. 6.7.
66. θ Eridani. Combined in the photometer with S. M. P. 585, A. G. C. 3224. Resulting magn. 3.13.
70. In H. P., — Eridani.
78. In S. M. P., for — Fornacis, read δ Fornacis.
88. Pleione. +23° 558, magn. 6.2. In Vol. XLIV, magn. 5.19.
90. A. G. C. magn. 6.7.
94. A. G. C. magn. 7.0.
108. A. G. C. magn. 6.6.
114. A. G. C. magn. 6.6.
117. A. G. C. magn. 6.5.
121. A. G. C. magn. 7.1.
132. A. G. C. magn. 6.4.
139. A. G. C. magn. 6.8.
144. A. G. C. magn. 7.1.
145. A. G. C. magn: 6.9.
148. A. G. C. magn. 7.
149. −5° 1320, magn. 7.8.
153. A. G. C. magn. 7.
154. A. G. C. magn. 6.6.
155. A. G. C. magn. 6.8.
156. A. G. C. magn. 7¾.
158. A. G. C. magn. 6.7.
159. ζ Orionis. Combined in the photometer with H. P. 1046. Resulting magn. 1.89.
180. A. G. C. magn. 7.0.
188. A. G. C. magn. 6.3.
200. A. G. C. magn. 6¾.
202. A. G. C. magn. 6.9.
206. A. G. C. magn. 7¾.
207. A. G. C. magn. 6.6.
209. A. G. C. magn. 7.1.
215. A. G. C. magn. 6.8.
217. A. G. C. magn. 7¼.
218. A. G. C. magn. 7.
222. In H. P., — Canis Majoris.
226. A. G. C. magn. 6.6.
228. A. G. C. magn. 7¼.
229. Combined in the photometer with S. M. P. 1709. Resulting magn. 5.80.
230. In H. P., — Canis Majoris.

232. A. G. C. magn. 6.3.
234. A. G. C. magn. 7.0.
236. A. G. C. magn. 6.5.
237. A. G. C. magn. 7.
239. A. G. C. magn. 7¼.
240. A. G. C. magn. 7¼.
241. A. G. C. magn. 6.8.
248. In H. P., — Canis Majoris.
249. A. G. C. magn. 6.5.
250. A. G. C. magn. 6.8.
254. A. G. C. magn. 7.
259. A. G. C. magn. 7.0.
261. In H. P., — Canis Majoris.
266. A. G. C. magn. 7½.
267. A. G. C. magn. 6.7.
270. A. G. C. magn. 6.3.
272. In H. P., — Argus.
276. α Geminorum. Combined in the photometer with H. P. 1424. Resulting magn., 1.56.
277. In H. P., — Argus.
278. A. G. C. magn. 7.0.
279. A. G. C. magn. 6.6.
280. A. G. C. magn. 7.0.
284, 285. In H. P., κ Argus.
286. A. G. C. magn. 6.9.
287. A. G. C. magn. 7.2.
289. A. G. C. magn. 6.7.
291. In H. P., — Argus.
293. In H. P., — Argus.
294. In H. P., τ Argus.
295. A. G. C. magn. 7.
296. In H. P., — Argus.
297. A. G. C. magn. 6.8.
298. A. G. C. magn. 7.2.
301. A. G. C. magn. 6.6.
303. In H. P., o Argus
306. A. G. C. magn. 6.3.
307. In H. P., ξ Argus.
312. A. G. C. magn. 6.9.
319. In H. P., e Argus.
322. A. G. C. magn. 6.7.
323. In H. P., — Argus.
325. A. G. C. magn. 6.5.
327. A. G. C. magn. 7½.
330. A. G. C. magn. 6.7.
331. A. G. C. magn. 6.6.
332. A. G. C. magn. 6.7.
335. A. G. C. magn. 7½.
337. A. G. C. magn. 7.1.
338. A. G. C. magn 7½.
340. A. G. C. magn. 7½.
341. In H. P., ι Argus.
344. A. G. C. magn. 6.7.
349. A. G. C. magn. 6.6.
354. A. G. C. magn. 6.3.
355. A. G. C. magn, 6.6.
360. A. G. C. magn. 7½.
361. A G. C. magn. 6.9.
362. A. G. C. magn. 6.8.
396. In H. P., o^3 Argus.
399. Z. C. 8^h 4141, magn. 9.
407. A. G. C. magn. 7.1.
410. A. G. C. magn. 6.8.
421. A. G. C. magn. 6.6.
426. A. G. C. magn. 6.7
430. A. G. C. magn. 6.8.
431. In H. P., — Argus.
432. A. G. C. magn. 7¼.
436. A. G. C. magn. 6.7.
437. In H. P., — Hydræ.
445. A. G. C. magn. 6¾.
451. A. G. C. magn. 6.4.
453. A. G. C. magn. 7¾.
463. A. G. C. magn. 6.5.
467. Gaseous nebula, N. G. C. 3242, −17° 3140.
468. A. G. C. magn. 6.8.
471. A. G. C. magn. 6.6.
475. A. G. C. magn. 6.7.
479. A. G. C. magn. 7.
480. A. G. C. magn. 6.8.
482. A. G. C. magn. 7¼.
483. A. G. C. magn. 7½.
486. A. G. C. magn. 6.6.
487. A. G. C. magn. 6.6.
490. A. G. C. magn. 6.8.
492. A. G. C. magn. 7¾.
494. A. G. C. magn. 7.1.
495. A. G. C. magn. 6.4.
496. A. G. C. magn. 7¾.
498. A. G. C. magn. 7½.
499. Z. C. 10^h 2684, magn. 8.7.
503. A. G. C. magn. 7½.
507. A. G. C. magn. 8½.
508. A. G. C. magn. 6.6.
510. A. G. C. magn. 6.8.
511. A. G. C. magn. 6.5.
513. A. G. C. magn. 6.9.
516. A. G. C. magn. 6.3.
519. A. G. C. magn. 7.
520. A. G. C. magn. 6.7.
522. A. G. C. magn. 7¾.
524. A. G. C. magn. 6.7.
525. A. G. C. magn. 8.
526. A. G. C. magn. 6.9.
529. A. G. C. magn. 6.4.
531. A. G. C magn. 8½.
534. A. G. C. magn. 7.0.
536. A. G. C. magn. 7¼.
537. In H. P., χ Hydræ.
538. A. G. C. magn. 7.1.
539. In H. P., — Hydræ.
540. A. G. C. magn. 7.3.
546. A. G. C. magn. 7½.
548. A. G. C. magn. 7.
550. A. G. C. magn. 7¼.
552. A. G. C. magn. 6.6.
559. A. G. C. magn. 7¾.
563. A. G. C. magn. 6.6.

567. A. G. C. magn. 6.7.
580. A. G. C. magn. 6.9.
581. A. G. C. magn. 6.3.
582. A. G. C. magn. 6.3.
594. A. G. C. magn. 6.9.
602. A. G. C. magn. 6.5.
603. A. G. C. magn. 7.0.
604. A. G. C. magn. 6.8.
608. A. G. C. magn. 6.8.
610. A. G. C. magn 6.5.
622. A. G. C. magn. 6.9.
627. A. G. C. magn. 6.8.
628. A. G. C. magn. 6.6.
629. A. G. C. magn. 6.6.
630 A. G. C. magn. 6.7.
639. A. G. C. magn. 6.6.
644. A. G. C. magn. 7.2.
646. A. G. C. magn. 6.6.
650. A. G. C. magn. 6.8.
653. A. G. C. magn. 7½.
659. A. G. C. magn. 6.4.
664. A. G. C. magn. 6.8.
665. A. G. C. magn. 6.9.
668. A. G. C. magn. 6.7.
675. A. G. C. magn. 6.7.
677. A. G. C. magn. 6.6.
679. A. G. C. magn. 6.9.
681. A. G. C. magn. 7.0.
684. A. G. C. magn. 7.0.
689. A. G. C. magn. 6.5.
695. A. G. C. magn. 6.8.
704. In H. P., — Hydræ.
705. A. G. C. magn. 7.
708. A. G. C. magn. 6.3.
709. In H. P., — Hydræ.
710. A. G. C. magn. 7½.
723. In H. P., — Hydræ.
726. In H. P., — Hydræ.
731. In H. P., — Hydræ.
733. A. G. C. magn. 6.9.
738. In H. P., — Lupi.
739. In H. P., γ Scorpii.
741. A. G. C. magn. 6.8.
742. A. G. C. magn. 6.8.
743. A. G. C. magn. 6.4.
750. A. G. C. magn. 6.3.
751. A. G. C. magn. 6.5.
754. A. G. C. magn. 6.7.
757. A. G. C. magn. 7.
759. A. G. C. magn. 6.9.
761. In H. P., δ Lupi.
765. A. G. C. magn. 6¾.
771. A. G. C. magn. 7.0.
779. A. G. C. magn. 6.8.
781. In H. P., — Scorpii.
786. In H. P., — Scorpii.
788. In H. P., o Scorpii.
790. A. G. C. magn. 7½.
808. A. G. C. magn. 6.4.
810. β Scorpii. Combined in the photometer with H. P 2691, A. G. C. 21806. Resulting magn. 2.91.
812. A. G. C. magn. 6.5.
821. In H. P., — Scorpii.
824. A. G. C. magn. 6.6.
827. ε Normæ. Combined in the photometer with S. M. P. 5640, A. G. C. 22244. Resulting magn. 4.67.
846. A. G. C. magn. 6.6.
847. A. G. C. magn. 6.8.
849. A. G. C. magn. 6.6.
852. A. G. C. magn. 7½.
855. A. G. C. magn. 6.5.
861. A. G. C. magn. 6.4.
862. In H. P., — Ophiuchi.
863. A. G. C. magn. 6.3.
868. A. G. C. magn. 6.4.
869. A. G. C. magn. 7½.
870. In H. P., — Ophiuchi.
873. A. G. C. magn. 6.7.
875. A. G. C. magn. 6.4.
878. In H. P., — Ophiuchi.
889. A. G. C. magn. 6.7.
893. A. G. C. magn. 6.5.
900. A. G. C. magn. 7.
902. A. G. C. magn. 7½.
903. This star is −21° 4864, and is not in the A. G. C.
906. A. G. C. magn. 7½.
909. A. G. C. magn. 7½.
912. A. G. C. magn. 6.4.
914. A. G. C. magn. 6.7.
916. A. G. C. magn. 7.
926. A. G. C. magn. 6.8.
928. A. G. C. magn. 6.6.
930. A. G. C. magn. 6.6.
931. A. G. C. magn. 7.
932. A. G. C. magn. 6.3.
941. A. G. C. magn. 6.8.
943. A. G. C. magn. 7.0.
953. A. G. C. magn. 6.5.
955. In H. P., — Sagittarii.
956. In H. P., ξ Sagittarii.
958. A. G. C. magn. 6.6.
959. A. G. C. magn. 6.9.
964. A. G. C. magn. 7.5.
966. A. G. C. magn. 6.8.
974. A. G. C. magn. 7.
975. β^1 Sagittarii. Combined in the photometer with S. M. P. 6798, A. G. C. 26486. Resulting magn. 4.10
978. A. G. C. magn. 6.6.
979. A. G. C. magn. 7.
981. In H. P., — Sagittarii.
982. In H. P., h Sagittarii.
994. A. G. C. magn. 6.8.
1001. A. G. C. magn. 6.6.
1004. A. G. C. magn. 7.0.
1005. A. G. C. magn. 7.
1006. A. G. C. magn. 7.
1019. A. G. C. magn. 6.9.
1023. A. G. C. magn. 7½.

1024. A. G. C. magn. 6.8.
1025. A. G. C. magn. 6.8.
1029. A. G. C. magn. 6.9.
1030. A. G. C. magn. 8.
1031. A. G. C. magn. 6.7.
1053. A. G. C. magn. 6.3.
1055. A. G. C. magn. 7.2.
1060. A. G. C. magn. 6.4.
1063. A. G. C. magn. 6.8.
1071. A. G. C. magn. 6.9.
1076. A. G. C. magn. 6.8.
1080. A. G. C. magn. 6.6.
1086. A. G. C. magn. 7.2.
1088. A. G. C. magn. 6.6.
1104. A. G. C. magn. 6.8.
1108. A. G. C. magn. 6.9.
1110. A. G. C. magn. 7¼.
1112. In H. P., — Piscis Austrini.
1113. A. G. C. magn. 6.7.
1115. A. G. C. magn. 7.1.
1119. A. G. C. magn. 6¾.

Table XVIII gives the additional plate numbers for all stars whose spectra were examined on more than three plates. The first column gives the number of the star taken from the first column of Table XVII. As in Table XVII, the left hand figure, 1, is omitted when the number is 10,000 or greater.

TABLE XVIII.

ADDITIONAL PLATE NUMBERS.

No.	Plate Numbers.
2	5883,5973,6835,7673,7704,7795,8006,0055
3	7151,7239,7804,7843,8759,9993
4	5932,7653,7719,7910,8747,8943,9965
5	6136,7643,7717,7793,7849,7888,7900,7954,8767,8778,8878,8925,9348,9962,9980,0000
6	6889,6953,7100,7717,8013,8059,8767,8789,8793,9365
7	5295,5341,5583,6873,6931,7171,8842,8856,9850
8	6827,6935,6947,7101,7162,7163
9	5966
10	5966
11	5445,5704,6963,7085,7160,7247
12	5445,5704,6963,7085,7160,7247
13	7247
15	5966
18	5884,7091,7301
19	7197,7312,8053,8824,8829,8834,8868
20	5981,6168,6936,7197,7312,7993,8053,8824,8829,8834,8868
21	9893,0057,0064,0070,0121,0127,0141
22	9815,9842,0058,0072
23	5826,6964,7061,7201,7209
24	0122
25	5957,6890,6903,7728,7805,7855,8930,9354,0097,0122
26	7152
27	9816,0061,0076
28	0059,0065,0111
29	5908,6965,7216,7217,7255,7799,7863,8041,8760,8863,9349,9352
31	5949,7240,7794,8047,8066,8130,8768,9359
32	5896,6184,7607,7729,7831,7893,7916,7943,7963,8070,8086,8093,8769,8926,9966,9977,9996
33	5261,5302,5419,5933,5934,6146,6884,7109,0123
34	9835,0062,0071,0108
35	5834,6902,6948,7144,7302
39	5925,7181
41	5270,7062,7271,8005,8184,8863,8887,0011
43	7920,8017,8071,8087,8748,8873,8944,8947,9982,0006
44	8037
45	0112
47	6874,6937,7123,7293,8037
49	7256,7800,8007,8761,0043
50	7806,8131,0034
51	5950,7153,7218
52	7134,7172,7191
53	6954,7198,7279
55	5343,5958,5968,5974,5982,5983,6169,6932,7164,7165,7272,8054,8794,8825,8835,8867
57	5916,5967,6176,7110,7202
58	7102,7241
61	6239,6940,6966,7102,7145,7228,7241
62	7086,7210
63	7182
65	6157,7154,7219,7249
66	7706,7921,8141,8749,8879,8945,9985,0002,0018,0021,0025,0039,0056
67	6185,7087,7294,7295,7303
69	7322,7989,8027,8207
70	6192,6261,7116,7856,8060,8142,8190
72	8029,8143,8762,8874,9353,0017
75	7079,7146,7309
76	5975,7314
77	7229
78	6148,7280
79	8127,8158,8179,8180
80	7211
81	8127,8158,8179,8180
82	8127,8158,8179,8180
83	8127,8158,8179,8180
84	8127,8158,8179,8180
85	5335,6193,7258,8016,8185
86	7232,8061
87	8127,8158,8179,8180
89	7258,8016
91	5327,5960,7176
92	5327,5960,7176
93	7193,8048,8888,9355
95	5495,7977,8008,8072,8323
98	5969,6131,6177,6194,6251,6941,7078,7173,7250,7313,8837
99	6177,6194,6251,6941,7078,7173,7313,8837
100	5969,6131,6177,6194,6251,6941,7078,7173,7250,7313,8837
101	7220,7233,8055,8208,8307
102	7220,7233,8055,8208,8307,8770,0007
103	7323,8132,8342,0035
104	7088,7089
105	6140,7242,8137,8333
107	7094,8196,8334,8889
109	7147,7174,7221,7251
110	5428,6141,7315,8191,8324,8976
111	4530,7922,7964,7965,8106,

No.	Plate Numbers.	No.	Plate Numbers.	No.	Plate Numbers.
	8112,8118,8218	191	8978	309	7230
112	5428,6141,7315,8191,8324,	193	3861,3865,3871,3872,3877,	312	7230
	8976		3878,3880,3888,3889,3892,	314	7226
113	8018,0046		3979,4597,5307,6163,6241,	316	6404,6413,6421,6444,6456,
115	7234		7801,7813,7897,8114,8931,		6507,8039,8050,8057,8063,
116	6186,7177,7304		0013		8067,8125,8128,8129,8136,
119	0098,0102,0109	194	7237,7327		8139,8140,8174,8175,8181,
120	6253,7166,7310	195	7327		8182,8187,8193,8199,8205,
121	7310	196	7214		8210,8215,8484,9014
122	8186	197	7327	317	9421,9442,9449,9456,9489
123	0098,0102,0109	199	7214	320	0131
125	7968,7971,7984,8099,8109,	203	8266,8298	324	6154,6301,6320,6329,6336,
	8219	205	3969,3970,3971,3972,3973,		6337,6345,6355,6375,6385,
126	4532,7896,7945,7966,8096,		3999,4000,4001,4085,7946,		6395,6404,6413,6421,6444,
	8104		7967,8094,8097		6456,6465,6507,8039,8050,
127	7296	208	7297,8273,8299		8057,8063,8067,8068,8073,
128	6240,7167,7296	211	8344		8074,8080,8081,8125,8128,
130	7178	212	7326,8248		8129,8136,8139,8140,8147,
131	7296	213	6274,7212		8174,8175,8181,8182,8183,
132	7167,7296	219	6217,8395		8187,8193,8199,8205,8210,
134	8028,8935,9986,0152	220	6217,8395		8215,8394,8484,8502,9007,
136	4041,7979,8119	227	0008,0154		9014,9051,9058,9076,9442,
138	8209,8265,8450,8890,8977	231	6255,8198,8326		9449,9456,9489
152	8119	233	0156	327	6345,6421,6456,6507
157	6196,8213,8335	244	7224,7391	328	6329,6337,6345,6355,6375,
161	0128,0134,0135	245	6432,6455,8300,8308,8309,		6385,6404,6413,6421,6456,
162	8138,8145,8214,8231,8795,		9434,9441		6465,6507
	8875,8939,0001,0030,0144	248	6432,6455,6479,8274,8300,	329	6329,6337,6345,6355,6375,
165	6231,6300,6319,6344,6354,		8308,8309,9434,9441		6385,6404,6413,6421,6456,
	6365,6374,6394,7184,7406,	252	7328,7395		6465,6507
	7993,8038,8043,8049,8056,	256	7215,8249,8253,8258,8336,	331	6320,6329,6337,6355,6375,
	8062,8133,8144,8221,8232,		8365,8891,8932,8968		6404,6413,6421,6456,6465,
	8343,9006,9013,9351,9356,	258	7215,8249,8253,8258,8336,		6507
	0074,0092,0101,0136		8365,8366,8891,8932,8968,	332	6320,6329,6337,6355,6375,
166	8256		8995,9000,9050,0158		6404,6413,6421,6456,6465,
167	8192,8325,8936,0003,0103,	263	7215,8249,8253,8258,8336,		6507
	0114,0149		8365,8366,8891,8932,8968,	335	6413,6421,6456,6465,6507
168	7305		8995,9000	339	5354,6155,6257,7421,8188,
169	0129,0136	265	7215,8249,8253,8258,8365,		8228,8229,8230,8233,8234,
171	7222		8366,8891,8932,8968,8995		8241,8245,8994,9078,0155
172	7957,7972,8113	268	8345,8990	340	6456
173	7188	269	8955,0150	341	8211,8242
174	8220	273	8355,8436,8973	343	0118
177	7252	283	4031,4042,8095,8098	346	7505,9418,0089
178	6219,7236	299	8360,8397	347	6266,7505,8472,8478,8513,
179	8272,8430	303	8337,8352		8514,0089,0153
184	7156,7223	304	6234,6276	348	9418,0089
185	6264,7190,7311	306	8259,8352	352	7422
187	7316	307	8275,8337,8352	358	7246
190	7194	308	6173,7230	359	9418,0089

No.	Plate Numbers.
371	6277,7330
372	6277,7330
373	8969,9008
376	0142
377	0142
382	6405,8367,9102
384	8367,9102
390	8269,8412,8415,9001
391	6422,6423
392	8254,0148
402	9415,0139
405	0132
411	7344
413	4061,6208,8195,8356,8956,0159
414	8473
417	6246,6356,6457,6508,6549,6555,6560,6565,7595,8260
425	6303,7397,7513,8473,8996
428	8200,8206
429	6246,6356,6457,6508,6549,6555,6560,6565,7595,8260,0143
435	6509,6550,6556,6566,7385,8189,8201,8212,0146
439	8381
440	8268
442	8338,8339
460	9002
461	8431,8437
462	6279,7523,7546,8243
464	9407
465	9407,9431,9435,9457,9464,9467,9471,9490
470	7345,7438
472	9249,9400,9431,9457
476	6458,6510,6551,6557,6561,6567,6591,8237,8373,9012,9015,9036
477	6271,7521,7522,8349,8357,8369,8451
481	9249,9370,9400,9424
485	8503
487	9400
495	6487
497	4725,4801,4868,4869,5568,6358,6480,6592,7361,7415
499	4709
500	5563,6280,6487
504	3965,3966,3967,4036,5563,6280,6487,7346,7516,8407,9184,9185
505	4725,4801,4846,4868,4869,5568,6358,6480,6592,7361,7415
506	4725,4801,4846,4868,4869,5568,6358,6480,6592,7361,7415
509	4036,5563,6280,6487
512	4725,4801,4846,4868,4869,6358,6480,6592
514	6434,6435,7538,8251,9187,0160
515	6480
517	6487
518	5563,6280,6487
519	4869,5568,6480
520	4869,5568,6480
528	6407,6425,6511,7380,7416,8294,8454
532	7381,7460
540	4754,6292,7355
542	9425,9468,9634,9732
544	6348
551	6292,7355,7382,7417
552	6292,6348,7382,7417
553	6525,6687
556	7357,7377,7431
557	7357,7377,7431
561	6526,7360,7373,7437
562	7506,8414,8486,9016
569	9738,9752
572	8418,9003
576	7372,7400
587	7362,7432
588	8295,8332,8341
589	7514,8295,8332,8340,8341,9197
591	8438
593	6512
595	8432,9004
600	6333,6334,8404,8433,9235
604	6638,7359,7410
606	6418,6638,7359,7378,7410,7515,8399,8416,8997,9699
607	
609	6489,6544
611	6369,7401,7576,7635,7636,9180
613	6408,6501,6569,8408,8474,8492
614	8262,9188
615	6583
616	7539,8479,9201
617	6360,6652,7585
618	6536,6583,7358
619	6360,6652,7585,9192,9193
622	6583
624	6558,6602,7540,8423,8439,8504,9011,9017,9037,9227
626	6295,7364,7402,7524,7632,7633,7644,8255,8261,8361,9186,9652,9665,9695,9733,9759
632	5642
633	6559,6639
634	7632,9119,9402,9458,9627,9652,9665,9674,9684,9695,9733,9759
635	6390,6447,6471
636	6390,6447,6471
637	6471
638	7634,8419,9018
641	9472,9775,9817
645	9397,9408,9465,9469,9644,
646	9734
647	6593
648	9387,9408,9465,9469,9644,9767,9780.9828 9767,9780,9828
649	9645,9734,9818,9836
651	9635,9645,9734,9776,9884
652	8270,8400,8413,9038,9236
654	8446,9198
655	6341,6584
656	4892,6341,6584
657	9473,9781
658	9739,9753,9766
660	6623
663	7547,8377,9148
665	6460,6562,6670
666	7403
667	6460,6562,6670
670	5633,7596,8362
672	5633,7596,8362
674	5601,5620,6391,6570,6578,6612
676	6578,6612
678	8263,9168,9228,9273,9494,9498,9504,9509,9514,9518,9522,9526,9530,9536,9538,

No.	Plate Numbers.
	9540,9542,9547,9556,9563,9569,9571,9574,9575,9582,9585,9589,9595,9601,9608,9616,9617,9618,9620,9626,9633,9642,9653,9673,9675,9682,9685,9686,9689,9691,9694,9700,9705,9706,9712,9714,9716,9719,9721,9723,9726,9746,9789,9856,9858,9867,9905,9938,9942
682	8384,8461
683	5629,5630,6370,6449,6640
685	5630,6370,6399,6449,6585,6640
687	4057,4058,4059,4596,5663,7365,7490,7525,7526,7533,7534,7535,7536,7537,7577,7639,7640,7911,8376,9029,9031,9199,9557
690	6419,6420,6472
691	6527,8297,8405,8417,9932
692	7491,7648,9564
694	6342
696	5696,6410,6502,6653
697	6624,7904
698	8389,8390,8480
699	5565,6342
704	6579,7404,9837
709	7439
713	5665,6297,6429,6430
714	8493,8505,9052,9053,9141,9162,9194,9207,9224,9280,9290,9312,9495,9499,9505,9510,9515,9519,9523,9527,9531,9539,9548,9576,9583,9602,9609,9619,9666,9861,9911
716	5760,6392,6473,6654,6688,7366,7418,7484,7541,7556,7557,7560,7561,7562,7572,7573,7645,7901,8363,8732
717	6392,6473,6654,6688,7366,7418,7484,7541,7556,7560,7561,7562,7572,7573,7645,7901,8363,8732
718	7567,8487,8620,9149
720	7548,7549,7558,7649,9189
721	6595,6655,6846,7411,7419,8434,8462,8613,9286
726	7405,7455
731	5118,5862,6528,6613,7440
732	5621,7412,9845
735	5885,7485,7586,8264,8271,8374,8420,8424,8435,8552,8572,9010,9028,9032,9039,9041,9042,9044,9047,9054,9060,9077,9079,9138,9161,9172,9179,9181,9202,9225,9229,9272,9274,9282,9291,9294,9296,9299,9309,9315,9506,9511,9516,9520,9524,9532,9541,9549,9570,9610,9676,9724,9861,9868,9900
736	8271,8374,8420,8424,8435,8447,8572,9032,9039,9042,9047,9079,9161,9172,9225,9229,9272,9274,9296,9315,9506,9516,9520,9524,9532,9541,9549,9610,9868
739	5614,6537,8378,8475,9237
746	9142,9169
748	6604,7502,8364,8455,9019,9283
750	9592,9598,9603,9811
751	6539
752	9579,9586,9592,9598,9603,9811,9829,9876
755	5898,6401
756	6516,7501,8421,8440,9245,9281,9295
758	9559,9566,9579,9586,9592,9598,9603,9811,9829,9876
760	6539
762	8658
763	6474,7592,8658
766	6539
767	6539
768	9811,9829
769	5101,5622,5898,6401,9598
770	5605,6305,6411,8391,8409,8488
772	8566,8633
773	5605,6305,6411,8391,8409,8488
774	6546
775	6462,6546
776	9812,9830,9877,9895
777	6305,6411,8391
780	6475
781	6641
782	8495
783	6353,6656,7456,9846
784	9812,9830,9877,9895
785	6353
786	5944,6476,6529,6641,6689,8401,8498,9150
787	5543,5667,6452,6642,7420,7441
788	6614,8425
789	5635,5945,6530
790	7456
791	5566,5762,6353,6412,6571,6656,7456,9846
792	5945,6530
794	6671,6856
796	8494
802	8481,8621,9143,9163,9218,9226,9284,9534,9543,9552,9572,9643,9651,9659,9663,9664,9667,9672,9683,9687,9688,9690,9692,9693,9696,9697,9698,9701,9702,9703,9704,9707,9708,9711,9713,9715,9717,9718,9720,9722,9725,9728,9745,9747,9748,9787,9788,9862,9869,9901,9906,9944,9956
803	7864,8626,9496,9503,9507,9512,9521,9525,9528,9533,9544,9550,9870,9912,9948,9971
804	7492,7646,8371,8392,8406,8470,8743,9203
805	9404,9444,9629,9768,9777
806	6442,6503,9098
813	7383,74433
815	7383,7433
816	5102,5110,5644,5937,6402,6431,6477,6517,6625,6746,6747,6847,7568,7818,7824,8441,8567
817	5102,5110,5644,5937,6402,6431,6477,6517,6625,6746,6747,6847,7568,7818,7824,8441,8567
821	6616,7117,7434,7457
823	5709,6308,6309,7579,8517,8559
825	9460,9587,9637,9735,9754,9782,9797,9855

No.	Plate Numbers.
826	5111,5936,5937,6402,6431,6477,6518,6747,6847,7568,7818,7824,8441,8525,8567
827	6597,6865,7095
828	9492,9561,9605,9831,9884,9896
829	6643,7486,7498,7587,7623,7637,7889,8082,8726,8727,8728,8729,9952
831	5623,6443,6848
833	5889
834	7622,8448,8509
835	5094,5623,5836,6443,7450
836	6310,8506
837	7542,7650,8379,8733,9292,9978
838	6310,8506
839	6310,7844,8422,8506,9949
840	7858,7912,8457,8735,9182
841	6463,6598,7691,8476
842	7626,7683,7687,7690,7694,7697,7700,7703,7707,7708,7709,7710,7711,7712,7713,7714,7715,7716,7720,7721,7722,7723,7724,7725,7726,7727,7730,7731,7732,7733,7734,7735,7736,7737,7738,7739,7740,7741,7742,7743,7744,7745,7746,7747,7748,7749,7750,7751,7752,7759,7761,7782,7790,7814,7820,7837,7840,7850,7851,7898,7902,7917,7919,7974,7980,8009,8045,8370,8411,8468,8526,8573,8627,9030,9040,9043,9045,9048,9080,9139,9164,9208,9230,9275,9300,9310,9553,9902
843	6325,6463,7691,7865,8471,8476
844	7683,7687,7690,7694,7697,7700,7703,7707,7708,7709,7710,7711,7712,7713,7714,7715,7716,7720,7721,7722,7723,7724,7725,7726,7727,7730,7731,7732,7733,7734,7735,7736,7737,7738,7739,7740,7741,7742,7743,7744,7745,7746,7747,7748,7749,7750,7751,7752,7759,7761,7782,7790,7814,7820,7837,7840,7850,7851,7898,7902,7917,7919,7974,7980,8009,8045,8370,8411,8468,8526,8573,8627,9030,9040,9043,9045,9048,9080,9139,9164,9208,9230,9275,9300,9310,9553,9902
845	5753,6325,6463,6598,7691,7865,8471,8476,9287
846	5753,6463,6598,7865,8476
848	5753,6325,6463,6598,7691,7865,8471,8476,9287
850	5753,6325,6463,6598,7691,7865,8471,8476,9287
851	6598,7691,7865,8471,8476
853	7817,8463,8499,8614
854	5830,6453,6644,6701,6866,7063,7064,7065
856	5830,6453,6644,6701,6866,7063,7064,7065
857	9599,9638,9740,9769,9805,9885
859	6364,6617,7598,8456,8607,8659,9055
860	9630,9792,9798,9878
861	6849
864	7426,7487,8496,8560
865	9656,9770,9806,9820
866	4887,5805,5819,6504,6657,6672,6849,7503,7810,7815,7823,7859,8051,8393,8482,8510,8518,8579,8622,8634,8746,9033,9046,9049,9061,9081,9140,9165,9209,9219,9276,9301,9311,9677,9727
867	4887,5805,5819,6504,6657,6672,6849,7503,7810,7815,7823,7859,8051,8393,8482,8510,8518,8579,8622,8634,8746,9033,9046,9049,9061,9081,9140,9165,9209,9219,9276,9301,9311,9677,9727
870	6749
872	5900,6326,6857,9082
873	6857
874	7593,8469,8615,8628,9151,9304
876	5679,5700,6645,7494,7641,7776,7969,8449,8464,8490,8507,8739
877	6464,7543,7656,7809,7816,7990,8052,8375,8442,8489,8500,8574,8792,9144,9170,9231,9246,9277,9302,9497,9502,9508,9513,9517,9529,9535,9545,9551,9573,9646,9668,9860,9863,9864,9871,9903,9939,9941,9943,9945,9950,9957,9959,9972,9990,0014
878	6478,6599,6627,7128
879	5679,5700,6645,7494,7641,7776,7969,8449,8464,8490,8507,8739
880	9741,9779,9813,9832
881	6645,6757
883	7642,9195,9660,9907
884	9742,9762
885	7652,8587
886	7819,8535,8608,9308
887	8638
890	9580,9729,9736,9778,9799,9821
891	6311,7618,7688,7826,9297
894	9600,9657,9755,9761,9814
895	9756,9886
897	8651,9669,9670
899	7569,7760,9200
900	6607,6739
904	5000,5071,5646,5821,6327,6607,6739,7124,9056
907	5796,5930,9034
913	5112,5716,7072,7563,7697,8561,8568,8600,8823,8827,9288,9946,0036
915	5095,5121,5680,7056,7103,7137,7179,7427
917	5806,5876,6505,6548,6554,6673
918	7552,7664,8497,8744,0040
919	7072,8823
922	7504,7651,7825,7906,8736,9196
923	4842,5232,5573,5581,5946,6802,6867,7066,7067
924	7580,9145,9298,9988
925	7092
927	7571,7866,8501,9191,9238,9960,9968,9994

No.	Plate Numbers.
929	5806,5876
934	7580,9145,9298
935	7580,9145,9298
936	7118
937	5016,5096,5808,6618
938	8090
940	9631,9749,9879
942	5780,6694,6858,7068
945	6803,7588,7676
947	8645,8660,8843
948	5104,5134,5154,5178,5618,5741,5822,5877,5938,6796,6850,7104,7111
949	5104,5134,5154,5178,5618,5741,5822,5877,5938,6796,6850,7104,7111
950	5765,7564,7647,7913,8483,8508,8741,9183,9709,9927,9963,9991,0019
951	6850
954	7135,7136
955	5786,7574,7846,8766,9288
956	5786,7574,7846,8766,9288,9554
957	9334,9640,9771
958	6850
960	6318,7129
961	7582,7833,9953
963	6541,7611,7834,8601,9293,9546,9908,0050
965	5764,7827
967	7581,7677,8569,8616,9210,9232,0022
968	5914
969	5764,7827
970	7096
972	7096,7613,8580,9951,0044
973	5901,6540,6541,7606,7611,7624,7834
975	5066,5717,5809,7093,7624,8623,9035,9220
976	5066,5717,5809,7093,7624,8623,9035,9220
977	6506,7619,7692,7777,8629,9239,0026
980	9412,9439,9562,9607,9658,9737,9763,9807,9880
981	6822,6892,7069
982	6822,6892,7069
985	5923,6758,6859,7073,7180
987	8091
988	5638
989	9750,9772,9888
990	6609,7614,7698,9083,9146,9247,0023
991	5003,5018,5067,5781,5788,5823,5939,6868,6869,6870,6915,7139
993	5003,5018,5067,5781,5788,5823,5939,6868,6869,6870,6915,7138,7139
996	5003,5018,5067,5781,5788,5823,5939,6868,6869,6870,6915,7138,7139
1000	6898,7058,7125
1002	5718,6897,6982,7105,7112,7428,8844,9839
1003	5073,5087,5097,5660,5915,6823,6898,7058,7125
1006	6898,7058,7125
1007	6949,7604,7769,8774
1008	9568,9647,9710,9730,9757,9793,9808,9889,0069,0107,0126,0133
1009	5688,7575,7589,7903,7908,7970,8088,8089,8519,8536,8617,8630,8730,9057,9233,9865,9930,9958,9961,9964,9973,9984
1010	5734
1011	5734,5902
1012	5879,6943,7583,7628,8775,9240,9581,9872,9954
1013	5734
1014	7074,7080,7860,7976
1015	6986,7074,7080,7600,7665,7860,7976,8661,9248,9987
1018	5810,7140
1020	9764,9881
1021	6983,7140
1022	7097,7119,7458,9662,9847
1024	6983
1026	7097,7119,7458
1027	4969,4989,5719,6797,6917,6983,7459,8859
1028	4459,4482,5080,5200,5272,5892,6518,6519,6520,7594,7671,7828,8520,9357,9671,9969,0015
1034	7059,7075,7130,8845
1036	5019,5078,5106,5123,5135,5143,5639,6860,6944,7113,7454,9840
1038	6933,8581,8639,8652,9678
1039	7148,9221
1040	5735,6760,6851,6899,6927
1041	5735,6760,6851,6899,6927
1043	5033,5686,5798,5880,6682,6861,6984,7168,7658,7684,7811,7841,8511,8646,8863,9147,9278,9313,0031,0054
1044	5033,5686,5798,5880,6682,6861,6984,7168,7658,7684,7811,7841,8511,9278,9313
1045	9731,9758
1046	4890,5676,6690,6691,6950,7098,7452,7685,7778,7861,8653,9234,0028
1047	7157,9455,9493,9588,9649,9731,9758,9800,9809,9897,0077,0120,0140
1049	5849,6798,6945
1050	5789,6824,7106,8788,8809,9171,9360
1051	5441,5689,7625,7821,7847,7886,8745,9241,9555,9976,9989,9992,0020,0045
1052	5124,5743,5911,6928
1054	6871,9848
1056	5864,6692,6832,6833
1057	6878,7544,7787,7891,7892,7909,7992,8084,8092,8588,8609,8640,8731,9279,9289,9679,9866,9924,9933,9934,9974,0041,0052
1058	6879,6919,7127
1062	6919,7127
1063	6951,8860
1064	6894,6951,8860
1065	6894,6951,8860
1066	5020,5107,5649,7666,7835,7987,8742,8776,8946,9874,9931,9979,0032,0037
1070	7082
1072	5758,5824,5986,7169
1073	5758,5824,5986,7169
1074	6683,7149
1075	9765,9774,9882
1082	5274,5782,7120,7121,7453
1083	7659,7678,7829,7899,7914,

No.	Plate Numbers.
	8107,8734,8737,8964,8979,9314,9929,9999,0048
1084	5893,6825,6934,7060,7107
1085	5137,5179,5184,5589,5904,5954,6768,6852,6900,7076,7195,8861
1087	6938,7672,7786,9316
1089	5812,5850,6886,6920,7158,7199,0119
1090	5703,5850,6886,6920,7158,7199,0119
1091	7667,7668,7669,7699,7779,7894,7895,7915,7942,7962,8085,8108,8512,8589,8635,8641,8738,8787,8929,8964,8979,9289,9314,9348,9364,9680,9875,9925,9947,9955,9995
1092	5838,7090,7099,7798,7862,7887,8012,8647,9358
1093	5582,5839,5963,5964,5971,6834,7207,9833
1095	5865,6887,6929,7115,7693,7812,7842,7992,8854,8777
1096	5582,7207
1097	5947,6887,6929,7115,7693,8854
1098	5851,6762.6880,6952,7770,7988,8058,8654,9361,0038,0053
1099	5988,6684,7785,7830,7848,9317,9681,0033,0042,0049
1100	6881,6962,7132,9834
1101	5800,5882,6853,6895,6946,7792,7836
1102	5800,5882,6853,6895,6946,7836
1105	5840,5955,6901,7150
1106	7083
1107	5217,5276,5894,6882,7208,9320,9330,9650,9841,9883
1109	5978,5979,6862,7143,9849
1111	7170,8841
1112	7200
1114	5956,6939,7122
1116	5791,5825,5980,6883,6921,7077,7133,7270,8855
1117	6922,7108,7278
1118	7084
1121	5965,6826,6888,6922,7108,7278,7307,8862

A list of all the stars, in Tables XVI and XVII, whose spectra are of the Orion type with one or more bright hydrogen lines, is given in Table XIX. The first seven columns of this table are taken from the second, third, fourth, fifth, sixth, seventh, and eighth columns of Table XVII. The eighth column gives the class to which the spectrum would belong, if all the lines were dark. The ninth column gives the brightness of the hydrogen lines. The estimates were made in the following manner: — The intensity of Hβ in the spectrum of μ Centauri was assumed as *10.* The intensity of Hβ in each spectrum taken with one and two prisms was then estimated by superposition upon Hβ in the spectrum of μ Centauri on Plates X 5633, and X 8362 respectively. The intensity of the other hydrogen lines was estimated by comparing those in each spectrum with Hβ. The intensities are printed in Italics to indicate that the lines are bright. In four cases Hβ, and in two of these Hγ also, have been found to be variable, being sometimes bright and sometimes dark. The laws regulating these changes have not yet been determined.

The tenth column gives numbers referring to the remarks following Table XVI.

TABLE XIX.

SPECTRA OF THE ORION TYPE HAVING BRIGHT HYDROGEN LINES.

M. P.	Constellation.	Des.	A. G. C.	R. A. 1900.	Dec. 1900.	Mag.	Class.	Hε	Hδ	Hγ	Hβ	Remarks.
				h. m.	° ′							
R	Taurus	—	—	3 43.3	+23 51	R	B 8 A	0	0	0	*2*	105
S 1217	Columba	α	6633	5 36.0	−34 8	2.74	B 5 A	0	0	0	*1*	18,97
S 1643	Canis Major	κ	8518	6 46.1	−32 24	3.90	B 2 A	*3*	*2*	*3*	*6*	18,48
—	Canis Major	—	8991	7 3.2	−23 41	R	B 3 A	0	0	0	*1*	82
H 1368	Canis Major	—	9181	10.2	−26 10	4.54	B 5 A	0	0	var.	var.	101
H 1370	Canis Major	ω	9198	10.7	−26 35	3.69	B 3 A	0	*1*	*2*	*4*	76
S 1856	Puppis	v^1	9326	14.8	−36 33	4.80	B 3 A	0	*1*	*3*	*5*	18,77
H 1472	Puppis	o	10182	43.9	−25 42	4.68	B 2 A	0	0	*1*	*3*	18,49
S 2336	Puppis	r	10963	8 9.7	−35 35	5.00	B 3 A	0	*1*	*2*	*4*	78
S 2787	Carina	E	12465	9 4.8	−70 8	4.76	B 3 A	0	0	0	*1*	18,79
S 3317	Vela	J	14145	10 17.2	−55 33	4.44	B 5 A	0	0	var.	var.	99
S 3406	Carina	p	14392	28.5	−61 11	3.62	B 5 A	0	0	*2*	*5*	18,98
S 4093	Centaurus	δ	16572	12 3.2	−50 10	2.81	B 3 A	0	*2*	*5*	*10*	18,74
S 4366	Crux	—	17542	48.8	−56 37	5.42	B 3 A	0	0	0	*2*	53
—	Musca	—	17717	56.3	−70 56	R	B 3 A	0	0	*4*	*5*	18,80
S 4676	Centaurus	μ	18773	13 43.6	−41 59	3.33	B 2 A	*2*	*3*	*6*	*10*	47
—	Centaurus	—	18859	47.7	−46 39	R	B 3 A	0	0	0	*2*	81
S 4820	Centaurus	—	19273	14 8.0	−56 37	5.22	B 3 A	0	0	0	*2*	18,81
S 4941	Centaurus	η	19737	29.2	−41 43	2.54	B 3 A Comp.	0	0	0	var.	83
S 5263	Apus	κ^1	20878	15 20.6	−73 2	5.61	B 5 A Pec.	0	0	0	var.	100
S 5809	Scorpius	ζ^1	22812	16 47.0	−42 12	4.96	B 1 A Pec.	0	0	0	*2*	40,43
S 6064	Ara	α	23694	17 24.1	−49 47	2.86	B 3 A	0	0	*2*	*7*	18,75

The following general notes on the spectra of the Orion type having bright hydrogen lines may be considered supplementary to the remarks on the individual spectra. When the dark lines only are considered, these spectra do not usually differ essentially from ordinary spectra of the Orion type. Generally, the Orion lines are very broad and hazy, sometimes appearing double. In the spectrum of ζ^1 Scorpii, however, all the lines are narrow, even those due to hydrogen. The reversal of the hydrogen lines is never complete. Dark borders are seen either on both edges or on one edge. The maximum brightness is at the line Hβ. When Hβ is intensely bright, the lines Hγ, Hδ, and possibly Hε, are also bright, and form a series decreasing in intensity. In this case, the dark borders to the bright Hβ are very faint. These dark borders increase in intensity with each hydrogen line of shorter wave length until the line Hζ, which is wholly dark, is reached. All the visible hydrogen lines of shorter wave length than Hζ are also dark. When Hβ is bright and moderately intense, the dark band on which it is superposed is always well seen. In this case, Hγ has a bright line separating, as it were, the broad dark Hγ into two portions. When Hβ is faintly bright, the dark band on which it is superposed is wide and well marked. The other hydrogen lines are then wide and hazy, often appearing double. Double reversals of Hγ and Hβ were found in the spectra of several stars. The dark bands on which the bright hydrogen lines are superposed appear to be complex in some spectra. For instance, in δ Centauri, on Plates X 8295 and X 8332, a distinct dark line is seen near the edge of shorter wave length of the dark band on which Hδ is superposed. In α Aræ, the hazy dark band on which the bright Hγ is superposed appears on some plates to be separated into several, indistinct, dark lines. Some other bright lines besides the lines of hydrogen are seen in many of these spectra. The most conspicuous of these are at wave lengths 4232 and 4584, approximately. In general, the others are faint, and appear to be spaces between dark lines, or bright edges to dark lines.

A list of the stars in Tables XVI and XVII, whose spectra are of the composite type, is given in Table XX. The first, second, third, fourth, fifth, sixth, seventh, and tenth columns are taken from Table XVII. The eighth column gives the class to which the brighter spectrum belongs, the ninth column gives the probable class or type of the fainter spectrum.

TABLE XX.

STARS WHOSE SPECTRA ARE OF THE COMPOSITE TYPE.

M. P.	Constellation.	Des.	A. G. C.	R. A. 1900.	Dec. 1900.	Mag.	Class of Br. Sp.	Class of Ft. Sp.	Remarks.
				h. m.	° ′				
S 2441	Carina	ϵ	11285	8 20.4	−59 11	1.74	K	Orion	202
S 4941	Centaurus	η	19737	14 29.2	−41 43	2.54	*B 3 A*	A 2 F	83
S 5229	Circinus	γ	20785	15 15.4	−58 58	4.41	B 5 A	F 8 G or G	102
H 2764	Scorpius	α	22314	16 23.2	−26 13	1.06	Ma	A or A 5 F	212
H 4096	Aquarius	c^3	31442	23 4.5	−23 00	4.89	G	A 2 F or A 3 F	194

A list of the stars in Tables XVI and XVII whose spectra show lines that are periodically double, is given in Table XXI. The first seven columns and the tenth column are taken from Table XVII. The eighth column gives the period. The ninth column gives the spectrum of the brighter component, the tenth, that of the fainter component. In the case of β Aurigæ, however, no difference was detected between the intensities of the lines of the two stars. β Lupi is not included in this list, because the lines have not yet been found to be periodically double. See Remark 44. A Remark on the spectroscopic binary, ζ Ursæ Majoris, which has not been photographed at Arequipa, will be found on page 95.

TABLE XXI.

SPECTROSCOPIC BINARIES

M. P.	Constellation.	Des.	A. G. C.	R. A. 1900.	Dec. 1900.	Mag.	Period.	Class of Br. Sp.	Class of Ft. Sp.	Remarks.
				h. m.	° ′		d.			
H 1100	Auriga	β	—	5 52.2	+44 57	2.07	3.984	A	A	142
S 2190	Puppis	—	10534	7 55.3	−48 58	4.50	1.454	B 1 A	B 3 A	41
S 4715	Centaurus	ζ	18897	13 49.3	−46 47	2.81	8.024	B 2 A	B 2 A	45
H 2671	Scorpius	π	21638	15 52.8	−25 49	3.08	1.571	B 2 A	B 2 A	46
S 5794	Scorpius	μ^1	22761	16 45.1	−37 53	3.26	1.446	B 3 A	B 3 A	73

CHAPTER XIV.

INTENSITIES OF LINES.

TABLE XXII gives the wave lengths and intensities of the lines and bands in the typical stars of seven classes of spectra, of which the first five contain bright lines, and are subdivisions of Class O, stars of the fifth type, the seventh is of Class B, the marked Orion type, and the sixth is intermediate between these two classes. Since only two of these stars have been photographed with more than one prism, the material for this table has been secured altogether from plates taken with the dispersion of a single prism. A complete list of the lines in the spectrum of ζ Puppis, as photographed with two prisms, is given in Table XXII with the exception of 3783.4, 4608.2, 5202.2, and 5414. The intensities of the lines in the spectrum of ϵ Orionis, as shown in an excellent photograph taken with three prisms, is given in the third column of Table XXIII.

The first column of Table XXII gives the designations of the lines of hydrogen and calcium. The additional hydrogen lines, first identified in the spectrum of ζ Puppis, are called, for convenience, $H\beta'$, $H\gamma'$, $H\delta'$, $H\epsilon'$, $H\zeta'$, $H\eta'$, and $H\theta'$. The line $H\beta'$, wave length 5414, does not appear in this table, because the plates here discussed do not include that portion of the spectrum. The second column of Table XXII gives the wave lengths of the lines and bands. The wave lengths are taken, in general, from Table IV, page 53. The wave lengths of the additional hydrogen lines are taken from the table contained in Circular No. 55. The wave lengths of the bright bands 4059, 4606, 4633, and 4688, are only approximate. The next seven columns give the intensities of the lines and bands found in the spectra of the stars whose designations are given at the head of the columns. When a line is bright, the number indicating its intensity is placed in Italics, when dark, in Roman type. To determine the intensities, a scale was adopted in which the intensity of the dark hydrogen lines in the spectra of α Canis Majoris and γ Centauri was assumed to be 100, and the intensity of the bright band 4688 in the spectrum of A. G. C. 8631 was assumed to be *100*. The intensities of the dark hydrogen lines in the spectra of ζ Puppis, 29 Canis Majoris, τ Canis Majoris, and ϵ Orionis, were estimated by superposing plates of each star respectively upon Plate X 6293, γ Centauri. It is difficult to compare intensities of lines on plates of different densities. Therefore, in estimating the intensities of the hydrogen lines in each of the four stars named above, a plate was selected having nearly the same density as Plate X 6293. The plate of each typical star was in turn superposed upon Plate X 6293, film to film, so that the ends of the same hydrogen lines in each spectrum coincided. Plate X 6155 was used for ζ Puppis; X 7231 for 29 Canis Majoris; X 6265 for τ Canis Majoris; and X 4041 for ε Orionis. The intensity of each hydrogen line in the typical star was then estimated by comparing it with the same line in the spectrum of γ Centauri. The intensities of the hydrogen lines of each typical star thus obtained from a plate of the same density as X 6293, were retained for the plates not comparable with X 6293, and in each case the intensities of the Orion lines were determined by comparison with the hydrogen lines on the same plate. In this way, it was hoped to keep the scale constant, and to eliminate large errors due to differences in length of exposure. When more than one plate was used the mean of the estimates of any given line was taken for its intensity. Plates X 6155, X 6257, and X 7421 were used for ζ Puppis; X 6265 and X 7231 for 29 Canis Majoris and τ Canis Majoris; X 3851 and X 4041 for ε Orionis. A line that was barely seen was called 1; a line that was faint, but distinctly seen, was called 2. For intensities 1 to 5, smaller differences could be estimated than when the intensity was greater. In the latter case, care was taken to preserve in each spectrum the relations of the more intense lines to the hydrogen lines. Small variations in intensities cannot be detected on plates taken with one prism, hence some slight differences will be noticed between the intensities given in this table for the lines in the spectrum of ε Orionis, and those given in Table XXIII, where a plate with the dispersion of three prisms was employed.

As stated above, the bright band 4688 in the spectrum of A. G. C. 8631 was taken as the standard in estimating the intensities of the bright bands in the spectra of classes Oa, Ob, Oc, Od, and Oe. The estimates were made in the same way as those of the dark lines in the spectra of ζ Puppis, 29 Canis Majoris, τ Canis Majoris, and ε Orionis. Owing to the width and haziness of the bright bands, the uncertainty in the estimates of intensities is greater than in the case of dark lines. Plates X 4065 and X 7355 were used for A. G. C. 15305; X 4108, X 4115, and X 4512 for A. G. C. 8631; X 5058 for A. G. C. 22763; X 6155, X 6257, and X 7421 for ζ Puppis; X 6265 and X 7231 for 29 Canis Majoris.

When a space is left blank it indicates that the corresponding portion of the spectrum is too faint to appear on the photograph. When the presence of a line is undetermined because of poor focus, faintness of the image, or proximity of an intense line or band which may obscure a faint line, the number is replaced by dots. When the line is not seen, although the region is included in the photograph and the focus is good, 0 is inserted. When a number is placed between two lines, it indicates that the combined intensity is estimated.

TABLE XXII.

LINES IN CLASSES O TO B.

0 5 07e 08

Des.	λ	Oa	Ob	Oc	Od	Oe	Oe 5 B	B
		A.G.C. 15305.	A.G.C. 8631.	A.G.C. 22763.	ζ Puppis.	29 Canis Majoris.	τ Canis Majoris.	ε Orionis.
Hο	3697.4							1
Hξ	3704.0							12
Hν	3711.8							10
Hμ	3721.9						8	18
	3728.1						..	1
Hλ	3734.2				10		10	18
Hκ	3750.2				12		15	20
	3760.1				0		..	5
Hι	3770.8				15		20	25
	3779.5				0		..	2
	3784.6				0		..	2
	3790.9				0		..	2
Hθ	3798.1				18	20	25	25
	3805.1				0	..		1
	3812.4				0	..	..	1
Hθ′	3815.7				3	..	..	..
	3819.2				0	15	15	15
Hη	3835.5				20	25	25	25
Hη′	3860.8				5	1	..	..
Hζ	3889.1				20	25	25	25
Hζ′	3924.0				7	3	4	2
	3926.8				0			
K	3933.8				2	2	5	2
	3964.6				0	0	1	3
Hε	3970.2		*1*		20	25	25	25
	3994.9		0		0	0	1	1
	4009.5		0		0	0	1	3
Hε′	4026.0		*2*	*1*	8	20	15	15
	4026.4		0		0			
	4059	*2*	*10*	*5*	0	3	0	0
	4069.4	0	0	0	0	2	5	5
	4072.0	0	0	0	0			
	4075.9	0	0	0	0	2	3	3
	4089.2	0	..	0	0	6	12	15
	4096.9	0	..	0	0	18	6	2
Hδ	4101.8	*2*	*15*	*3*	20	25	25	25
	4116.2	0	..	0	0	3	6	10
	4120.5	0	..	0	0	2	4	5
	4144.0	0	0	0	0	3	4	5
	4186.2	0	0	0	0	1	2	2
Hδ′	4200.7	0	*10*	*2*	10	5	4	1
	4254.1	0	0	0	0	0	0	2
	4318.0	0	0	0	0	0	0	2
	4320.7	0	0	0	0	0	0	
Hγ	4340.7	*3*	*10*	*4*	20	25	25	25
	4350.1	0	..	0	0	0	0	2
	4367.3	0	0	0	0	2	2	2
	4387.8	0	0	0	0	3	4	5
	4415.1	0	0	0	0	0	0	2
	4417.5	0	0	0	0	0	0	
	4471.8	*1*	0	*2*	1	15	15	15
	4481.4	0	0	0	0	1	1	1
	4514.5	0	0	*2*	0	5	3	2
Hγ′	4542.4	..	*12*	*3*	10	5	4	1
	4553.4	0	..	0	0	0	0	4
	4568.6	0	0	0	0	0	0	4
	4606	0	*12*	0	0	0	0	0
	4633	*100*	0	*20*	*8*	*3*	0	0
	4649.2	..	0	0	0	0	15	25
	4661.7	..	..	0	0	0	1	2
	4675.3	..	..	0	0	0	0	2
	4688	R	*100*	*40*	*20*	*8*	5	2
	4712.8	..	0	0	0	4	4	4
Hβ	4861.5		*10*	*3*	20	15	25	25
	4922.1		0	0	0	3	5	6

REMARKS.

3924.0, 3926.8. These lines are not separated on any plate. The first is an additional hydrogen line, and the second is due to helium. In ζ Puppis, the total intensity probably belongs to the hydrogen line, since in the spectrum of this star, helium lines are absent or faint. In 29 Canis Majoris, τ Canis Majoris, and ε Orionis, both lines may be present.

4026.0, 4026.4. These lines are not separated on any plate. The first is due to hydrogen, and the second to helium. In A. G. C. 8631, and in ζ Puppis, the line seen is assumed to be due to hydrogen, since helium lines are absent or faint in these spectra. In the typical stars, 29 Canis Majoris, τ Canis Majoris, and ε Orionis, both lines may be present.

4542.4. In 29 Canis Majoris, this line is bright on the edge of greater wave length.

4633. This wide bright band appears, in the spectra of Class Oa, to consist of two portions, as described on page 146. In 29 Canis Majoris, band 4633 is separated into two bright lines. This may be due to a dark line superposed upon the bright band.

4688. This bright band may be present in Class Oa. See p. 146. It diminishes in width in the spectrum of each typical star from A. G. C. 8631 to 29 Canis Majoris, where it is but little wider than the dark lines in the spectrum. The dark line in τ Canis Majoris and ε Orionis, which appears to be the reversal of this bright line, has slightly shorter wave length than the bright line in 29 Canis Majoris.

4861.5. In 29 Canis Majoris, this line is bright on the edge of greater wave length.

The wave lengths and intensities of all the lines found in the spectra of the typical stars of classes B, B 1 A, B 2 A, B 3 A, and B 5 A, are given in Table XXIII. In the spectrum of γ Gruis, Class B 8 A, a few solar lines are present which are not included in this table, but which are given in the description of the spectrum of this star on p. 153. The spectrum of λ Centauri appears to contain all the more intense solar lines found in the spectrum of α Canis Majoris, and is only included in Table XXIII, in order to show the intensities of the helium and hydrogen lines. The first column of Table XXIII gives the designations of the lines of hydrogen and calcium. The second column gives the wave lengths of the lines found in the Orion stars, from 3613 to Hβ. These wave lengths are in general taken from Table IV, page 53. Approximate wave lengths are given for twelve faint lines not included in Table IV. The wave lengths of the additional hydrogen lines are taken from the table contained in Circular No. 55. An error found in Table IV, in lines between Hζ and K, was corrected by a graphical interpolation from micrometric measures of Plate X 7945, β Orionis. The wave length 3947.8, given in Table IV, was found to be wrong, and the error was due to the correction being applied with the opposite sign. The corrected value, 3945.0, is given in Table XXIII. The next seven columns give the intensities of the lines in ε Orionis, β Centauri, γ Orionis, α Pavonis, φ Velorum, γ Gruis, and λ Centauri, respectively. The following plates were used for estimates of the lines between 3819.2 and Hβ: — for ε Orionis, X 8119 taken with three prisms; for β Centauri, X 8376 and X 7911 taken with two and three prisms, respectively; for γ Orionis, X 7978 taken with three prisms; for α Pavonis, X 8519 and X 8089 taken with two and three prisms, respectively; for φ Velorum, X 8402 taken with two prisms; for γ Gruis, X 9241, and for λ Centauri, X 8486, each taken with two prisms.

Plates taken with two or three prisms do not generally include lines of shorter wave length than 3819.2, or, if visible, these lines are too faint and hazy for their intensities to be estimated. For lines of shorter wave length than 3819.2, it is necessary to use plates of long exposure taken with one prism. Such a plate of the typical star of each class was not always available, in which case a plate of a similar spectrum was substituted. The following plates were used: — for Class B, Plate X 3856, δ Orionis; for Class B 1 A, X 4059, β Centauri; for Class B 2 A, X 4129, α Lupi; for Class B 3 A, X 5268, α Pavonis; for Class B 5 A, X 3859, α Eridani; for Class B 8 A, X 5689, γ Gruis; and for Class B 9 A, X 6499, λ Centauri.

In estimating the intensities of the hydrogen lines, X 7585, γ Centauri, and X 8097, α Canis Majoris, were used for plates taken with two and three prisms, respectively.

TABLE XXIII.

LINES IN CLASSES B TO B 9 A.

Des.	λ	B	B 1 A	B 2 A	B 3 A	B 5 A	B 8 A	B 9 A
		ε Orionis.	β Centauri.	γ Orionis.	α Pavonis.	φ Velorum.	γ Gruis.	λ Centauri.
	3613.		3					
	3634.	2	5					
Hσ	3683.5	0	0	0	0	0		
Hρ	3686.7	0	0	0	0	0		
Hπ	3691.5	0	1	0	0	1		
Ho	3697.4	8	5	0	0	15		
Hξ	3704.0	18	25	22	25	25		
Hν	3711.8	10	20	20	20	25		20
Hμ	3721.9	18	22	30	25	35		40
	3728.1	1	..	..	..	..		0
Hλ	3734.2	18	25	35	35	40		60
Hκ	3750.2	20	30	40	50	50	80	80
	3760.1	5	5	..	0	0	0	0
Hι	3770.8	25	35	40	50	60	80	90
	3779.5	2	..	..	0	0	0	0
	3784.6	2	..	..	0	0	0	0
	3790.9	2	..	..	0	0	0	0
Hθ	3798.1	25	35	40	50	60	80	90
	3805.1	1	..	..	0	0	0	0
	3812.4	1	..	..	0	0	0	0
	3819.2	15	18	20	20	10	2	0
Hη	3835.5	25	35	40	50	60	80	90
	3850.	..	..	..	..	0	0	0
	3854.2	..	..	..	..	0	0	0
	3856.2	..	..	1	3	8	0	0
Hη′	3860.8	..	..	0	0	0	0	0
	3863.2	..	..	1	..	5	0	0
	3864.	..	..	1	..	0	0	0
	3867.6	1	2	6	2	1	0	0
	3872.4	1	2	4	2	1	0	0
	3876.4	0	2	4	..	0	0	0
	3881.7	1	1	0	..	0	0	0
Hζ	3889.1	25	35	40	50	60	80	90
	3912.2	2	3	3	1	0	0	0
	3918.7	2	3	3	2	2	0	0
	3920.6			3	2		0	0
Hζ′	3924.0	..	0	0	0	0	0	0
	3925.9	..	..	1	0	0	0	0
	3926.8	2	3	5	6	5	0	0
K	3933.8	3	2	4	4	8	5	8

Des.	λ	B	B1A	B2A	B3A	B5A	B8A	B9A
		ε Orionis.	β Centauri.	γ Orionis.	α Pavonis.	φ Velorum.	γ Gruis.	λ Centauri.
	3936.	0	0	2	1	0	0	0
	3945.0	2	2	2	1	0	0	0
	3954.8	2	2	2	1	0	0	0
	3962.	2	0	0	0	0	0	0
	3964.6	3	3	7	5	2	0	0
H	3968.6	..	..	..	..	..	..	..
Hε	3970.2	25	35	40	50	60	80	90
	3975.2	1	..	1	0	0	0	0
	3982.8	2	2	1	0	0	0	0
	3994.9	2	3	5	1	0	0	0
	4009.5	4	7	10	10	5	1	0
Hε′	4026.0	15	0	0	0	0	0	0
	4026.4		20	22	22	12	8	5
	4033.	0	0	1	0	0	0	0
	4036.0	0	1	2	0	0	0	0
	4042.2	0	1	2	0	0	0	0
	4045.	0	0	1	0	0	0	0
	4069.4	3	3	3	1	0	0	0
	4072.0	2	3	3	1	0	0	0
	4075.9	3	4	3	1	0	0	0
	4084.9	1	3	2	0	0	0	0
	4089.2	15	5	2	0	0	0	0
	4093.7	1	1	1	0	0	0	0
	4096.9	4	2	1	0	0	0	0
Hδ	4101.8	25	35	40	50	60	80	90
	4111.2	0	1	1	0	0	0	0
	4116.2	10	2	0	0	0	0	0
	4120.5	5	8	6	6	3	2	..
	4128.5	0	1	1	2	3	3	3
	4131.4	0	..	1	2	3	3	
	4134.0	1	2	1	0	0	0	0
	4144.0	5	8	12	12	7	3	..
	4152.	0	0	1	1	0	0	0
	4154.7	2	2	2	2	1	0	0
	4163.	0	1	1	0	0	0	0
	4169.2	2	2	3	3	1	0	0
	4186.2	2	2	1	1	0	0	0
	4190.	2	2	1	1	0	0	0
Hδ′	4200.7	2	0	0	0	0	0	0
	4224.8	0	0	2	0	0	0	0
	4237.4	0	1	2	0	0	0	0
	4242.6	0	1	2	0	0	0	0
	4248.	0	1	1	0	0	0	0
	4254.1	3	4	2	1	0	0	0
	4267.4	2	3	5	5	3	2	0
	4276.7	2	3	2	0	0	0	0
	4285.1	2	3	2	0	0	0	0
	4291.	0	1	0	0	0	0	0
	4295.	0	1	0	0	0	0	0
	4304.4	1	2	2	0	0	0	0
	4318.0	3	2	2	0	0	0	0
	4320.7		2		0	0	0	0
	4327.3	1	2	1	0	0	0	0
	4334.5	1	2	0	0	0	0	0
Hγ	4340.7	25	35	40	50	60	80	90
	4346.	0	1	0	0	0	0	0
	4350.1	3	3	1	0	0	0	0
	4361.0	0	1	0	0	0	0	0
	4367.3	2	2	1	0	0	0	0
	4373.2	0	2	1	0	0	0	0
	4380.1	2	1	0	0	0	0	0
	4387.8	5	8	15	15	7	3	0
	4395.7	1	2	2	0	0	0	0
	4415.1	3	5	2	0	0	0	0
	4417.5				0	0	0	0
	4437.9	0	2	3	3	0	0	0
	4440.	0	1	1	0	0	0	0
	4447.7	0	2	2	0	0	0	0
	4453.	0	2	2	0	0	0	0
	4471.8	15	18	22	22	10	5	4
	4481.4	2	2	3	4	7	6	7
	4490.6	1	1	0	0	0	0	0
	4514.5	1	0	1	0	0	0	0
	4531.4	1	1	2	0	0	0	0
	4535.	1	0	1	0	0	0	0
Hγ′	4542.4	2	0	0	0	0	0	0
	4553.4	5	5	4	2	1	0	0
	4568.6	4	3	3	1	0	0	0
	4576.5	2	2	3	1	0	0	0
	4591.6	2	2	1	0	0	0	0
	4598.2	2	2	1	0	0	0	0
	4603.7	1	1	1	0	0	0	0
	4611.2	2	2	0	0	0	0	0
	4619.8	1	2	2	1	0	0	0
	4630.6	2	2	3	0	0	0	0
	4641.1	4	4	4	0	0	0	0
	4649.2	25	10	4	1	0	0	0
	4661.7	2	3	1	0	0	0	0
	4675.3	2	3	1	0	0	0	0
	4685.4	3	1	0	0	0	0	0
	4697.9	1	2	0	0	0	0	0
	4705.0	1	2	0	0	0	0	0
	4712.8	4	4	4	5	3	1	0
Hβ	4861.5	25	35	40	50	60	80	90

REMARKS.

3954.8 This line appears to have a faint component on the side of greater wave length in γ Orionis. This companion is also seen, but very indistinctly, in α Pavonis.

4318.0, 4320.7. In α Lupi, these lines are clearly separated, and are equally intense.

4346. This line is closely double on Plate X 8361 of β Crucis.

4350.1. This line is a fine double in β Crucis. It also appears double in α Lupi.

4361.0. This line is seen in α Lupi, but not in γ Orionis.

4387.8. This line is present in γ Gruis, and also the adjacent solar band, extending from 4383.7 to 4385.2. In λ Centauri, the Orion line is not present.

4415.1, 4417.5. These lines are separated on plates of β Crucis and α Lupi taken with two prisms.

4641.1. This line is wide in ε Orionis and γ Orionis, and double in β Centauri, α Lupi, and several other spectra.

Table XXIV is supplementary to Table XXIII, and gives the wave lengths and intensities of the lines between 4812.2 and 5875.9. The first column gives the designations of two lines of hydrogen, Hβ and Hβ′, and one of helium, D_3. The second column gives the wave lengths taken from the tenth column of Table XXVI. The next six columns give the intensities of these lines in spectra of classes B, B 1 A, B 2 A, B 3 A, B 5 A, and B 8 A. Since, in several cases, the typical stars already selected for these classes were not satisfactorily photographed on isochromatic plates, the intensities of these lines were estimated on the best photograph that had been secured of any spectrum in each class. The following plates were used: — for Class B, X 8119, ε Orionis, taken November 10, 1896, exposure 106^m; for Class B 1 A, X 9186, β Crucis, taken June 8, 1898, exposure 65^m; for Class B 2 A, X 8739, λ Scorpii, taken July 23, 1897, exposure 45^m; for

TABLE XXIV.

LINES IN CLASSES B TO B 8 A BETWEEN 4812.2 AND 5875.9.

Des.	λ	B	B 1 A	B 2 A	B 3 A	B 5 A	B 8 A
		ε Orionis.	β Crucis.	λ Scorpii.	σ Sagittarii.	α Eridani.	γ Gruis.
	4812.2	0	1	0	0	0	0
	4819.6	0	1	0	0	0	0
	4829.4	0	2	0	0	0	0
Hβ	4861.5	25	35	40	50	60	80
	4889.0	..	2	..	0	0	0
	4906.3	..	2	1	0	0	0
	4922.1	7	10	10	10	8	1
	4941.6	..	3	2	0	0	0
	4959.4	..	1	0	0	0	0
	4999.4	..	2	2	0	0	0
	5015.7	5	5	4	4	4	0
	5047.8	2	3	3	3	1	0
	5141.5	..	1	..	..	0	0
	5159.0	..	1	..	..	0	0
	5197.8	..	2	..	..	0	0
	5218.8	..	2	..	..	0	0
Hβ′	5413.6	2	0	0	0	0	0
	5588.	2	0	0	0	0	1
	5653.9	..	1	..	0	0	0
	5677.7	..	2	..	0	0	0
	5697.8	..	3	1	0	0	0
	5721.7	..	2	0	0	0	0
	5740.8	..	3	2	0	0	0
	5773.3	..	1	..	0	0	0
D_3	5875.9		20	10			

REMARKS.

4922.1. A parhelium line, belonging to series e.

4999.4. This line is ill defined in β Crucis, α Crucis, and β Centauri, and double in ε Canis Majoris, on X 8940.

5015.7. A parhelium line belonging to series d.

5047.8. A parhelium line belonging to series f.

5413.6. The additional hydrogen line, Hβ′. It has been photographed as a dark line in the spectra of ζ Puppis, ε Orionis, δ Orionis, ζ Orionis, δ Scorpii, and θ Carinæ.

5588. Present in ε Orionis, δ Orionis, and ζ Orionis. Approximate wave length obtained by estimating position with respect to solar lines in α Aurigæ and α Scorpii. The faint line in γ Gruis is probably one component of the solar band, 5587.0 and 5589.6.

5875.9. The helium line D_3. It is photographed in the spectra of λ Scorpii, α Crucis, β Crucis, α Muscæ, and β Centauri on the isochromatic plates, X 8739, X 8997, X 9186, X 9201, and X 9199, respectively, and also in δ Orionis on several plates taken with the 11-inch Draper telescope. This line is more intense than any other line of greater wave length than Hβ. It has been observed visually as a bright line in the spectrum of β Lyræ, and as a dark line in the spectrum of β Orionis. It was also photographed in β Orionis by Keeler in 1894. See Astronomy and Astro-Physics, Vol. XIII, p. 487. This line is bright on the edge of greater wave length in β Centauri, on X 9199.

Class B 3 A, X 7647, σ Sagittarii, taken June 29, 1897, exposure 65^m; for Class B 5 A, X 8926, α Eridani, taken October 14, 1897, exposure 60^m; and for Class B 8 A, X 8745, γ Gruis, taken July 24, 1897, exposure 60^m. All these plates were taken with two prisms, except that of ε Orionis, which was taken with three prisms. The scale of the intensities is the same as that in Table XXIII.

TABLE XXV.

LINES IN THE SPECTRUM OF β ORIONIS.

Designation.	λ	Int.	Designation.	λ	Int.	Designation.	λ	Int.
Hι	3770.8	25	Hε	3970.2	35	Solar	4352.0	3
Hθ	3798.1	35	Nitrogen	3994.9	4	Oxygen	4367.3	1
Helium	3819.2	15	Parhelium	4009.5	5	Parhelium	4387.8	6
Hη	3835.5	35	Helium	4026.4	10	"	4437.9	1
Orion	3854.2	4	Solar	4067.0	1	Helium	4471.8	10
Silicon	3856.2	6	Oxygen	4075.9	2	Magnesium	4481.4	10
"	3863.2	6	Hδ	4101.8	40	Solar	4508.5	1
Helium	3867.6	3	Helium	4120.5	5	"	4522.9	1
Parhelium	3872.4	3	Silicon	4128.5	8	"	4549.7	1
Hζ	3889.1	35	"	4131.4	8	Silicon	4553.4	1
Solar	3906.6	1	Parhelium	4144.0	6	"	4568.6	1
Orion	3918.7	4	Solar	4154.9	2	"	4576.5	1
"	3920.6	4	"	4163.9	2	Solar	4584.0	2
Parhelium	3926.8	5	"	4173.6	2	"	4629.9	1
K	3933.8	17	"	4179.5	2	Helium	4712.8	3
Orion	3936.	1	"	4233.6	4	Hβ	4861.5	40
Parhelium	3964.6	5	Carbon	4267.4	5	Parhelium	4922.1	10
H	3968.6	15	Hγ	4340.7	40	"	5015.7	8

A list of the lines in the spectrum of β Orionis is given in Table XXV. The identification of these lines was made by superposing the spectrum of β Orionis on X 7966, taken with three prisms, upon X 8119, ϵ Orionis, for Orion lines, and upon X 8109, α Aurigæ, for solar lines.

The first column gives the designations of the lines of hydrogen, calcium, and other substances with which these lines have been identified by spectroscopists. In the case of a number of the fainter lines, the words Orion and solar are used in this column to indicate whether the line is present in Orion or solar spectra. The second column gives the wave lengths of the lines taken from Tables VII, XXIII, and XXIV. The third column gives the estimated intensities of the lines on the same scale as that used in Table XXIII.

CHAPTER XV.

Wave Lengths of Lines.

The wave lengths of the greater portion of the lines in the spectra of the stars may be determined with accuracy from the wave lengths of lines in the solar spectrum, in the spectrum of hydrogen, or of other known elements. For other lines, the micrometer described on page 2 has been used. It has two screws at right angles to each other, the pitch of each being $\frac{1}{24}$ of an inch. These screws move a brass plate on which the photograph was placed beneath a fixed microscope. The position of each screw was read by a circle divided to thousandths. All of the measures were made by Miss F. Cushman. One screw only was used, and a setting was made on each line in the spectrum, moving the screw always in one direction. A second setting was made in the same way, and then a third. The measures are thus more nearly independent than if the three settings on each line had been made in succession.

The measurements of the Orion lines whose wave lengths are greater than $H\beta$, a few others of slightly shorter wave length, and as many hydrogen and helium lines as could be well seen, are given in Table XXVI. The designation of the line is given in the first column and is followed in the second, fourth, sixth, and eighth columns, by the means of the three readings, expressed in twenty-four thousandths of an inch. The corresponding residuals, found by subtracting the means from the individual readings, negative values being expressed by Italics, are given in the third, fifth, seventh, and ninth columns. Three plates were measured; X 8997 of α Crucis, taken Dec. 20, 1897, and showing two images, with exposures of 60^m and 27^m, respectively; X 9184 of θ Carinæ, taken June 8, 1898, exposure 60^m; and X 9186 of β Crucis, taken June 8, 1898, with an exposure of 65^m. Two measures only were made of each image on X 8997. Image 1 on this plate is so dense that lines between $H\epsilon$ and $H\beta$ were burned out. The measures of this image were only used in determining the wave lengths of three faint lines 5057.5, 5859.0, and 5888.6, which were not visible in image 2 on the same plate. The tenth column contains the wave lengths of the lines. For unknown lines they have been found as described below, for known lines they are assumed from previous determinations, and are inserted in heavy face type.

The eleventh column gives the residuals expressed in tenths of a unit, and found by subtracting the values given in the tenth column from those derived from the individual plates. When the wave length in the tenth column is derived from a single plate, the letter A is substituted for the residual.

TABLE XXVI.

WAVE LENGTHS OF THE ORION LINES BETWEEN 4812.2 AND 5888.6.

B1 B0 B1

Des.	α Crucis Image 1.	Resid.	α Crucis Image 2.	Resid.	θ Carinæ.	Resid.	β Crucis.	Resid.	λ	Resid.	
Hε	. . .	....	87186	*01*,01	85258	*26*,26,01	85097	*71*,26,44	**3970.2**	. . . .	H
Hδ	. . .	....	77816	39,*39*	75982	01,14,*16*	75729	15,*02*,*13*	**4101.8**	. . . .	H
Hγ	. . .	....	63442	*08*,07	61483	*05*,11,*06*	61350	06,*20*,15	**4340.7**	. . . .	H
	. . .	....	56726	*14*,13	54732	*25*,20,06	54590	04,*07*,04	**4471.8**	. . . .	He
	. . .	....	48704	*18*,18	. . .	......	46505	*01*,03,*01*	**4649.2**	. . . .	O++
	. . .	....	46156	*17*,16	. . .	......	43880	00,*02*,02	**4712.8**	. . . .	He
	. . .	....	. . .	....	. . .	......	40030	12,*08*,*03*	4812.2	. . . A	Si ++
	. . .	....	. . .	....	. . .	......	39755	02,*10*,09	4819.6	. . . A	Si ++
	. . .	....	. . .	....	. . .	......	39392	18,*28*,11	4829.4	. . . A	Si ++
Hβ	41658	02,*03*	40444	05,*04*	38358	*05*,08,*02*	38207	04,*06*,01	**4861.5**	. 1 1 1	H
	. . .	....	. . .	....	. . .	......	37226	*15*,*42*,58	4889.0	. . . A	?O+
	. . .	....	. . .	....	. . .	......	36611	03,*06*,03	4906.3	. . . A	O+
	39522	08,*09*	38290	*07*,07	36213	*10*,06,05	36071	*07*,*07*,14	**4922.1**	. 3 0 *3*	He (O+)
	. . .	....	37620	05,*04*	. . .	......	35373	*06*,09,*02*	4941.6	. 0 . 1	
	. . .	....	37020	05,*06*	. . .	......	. . .	......	4959.4	. A . .	
	. . .	....	. . .	....	. . .	......	33455	02,*04*,02	4999.4	. . . A	
	36369	08,*08*	35167	01,*01*	33052	*01*,*15*,15	32932	*16*,*02*,17	**5015.7**	.2 11 *1*	He
	. . .	....	34686	*120*,120	. . .	......	. . .	......	5031.2	. A . .	
	35338	*01*,01	34198	28,*27*	32058	*12*,01,10	31924	20,*08*,*12*	**5047.8**	. *15* 2 *7*	He
	35022	*48*,48	. . .	....	. . .	......	. . .	......	5057.5	A . . .	
	. . .	....	. . .	....	. . .	......	29005	15,10,*25*	5141.5	. . . A	
	. . .	....	. . .	....	. . .	......	28488	*19*,30,*11*	5159.0	. . . A	
	. . .	....	. . .	....	. . .	......	27358	*49*,01,49	5197.8	. . . A	
	. . .	....	. . .	....	. . .	......	26759	*13*,12,02	5218.8	. . . A	
	. . .	....	. . .	....	21741	*24*,01,24	. . .	......	**5413.6**	. . 2 .	He +
	. . .	....	. . .	....	. . .	......	15960	93,*34*,*59*	5653.9	. . . A	
	. . .	....	. . .	....	. . .	......	15445	*24*,*02*,25	5677.7	. . . A	
	. . .	....	17231	13,*13*	15194	01,*12*,12	15057	*27*,27,01	5697.8	. 13 4 *18*	Al ++
	. . .	....	. . .	....	. . .	......	14514	*36*,16,19	5721.7	. . . A	Al ++
	. . .	....	. . .	....	14279	09,*06*,*03*	14138	*08*,*17*,26	5740.8	. .10 *11*	
	. . .	....	. . .	....	. . .	......	13448	19,*89*,71	5773.3	. . . A	
	15172	06,*05*	. . .	....	. . .	......	. . .	......	5859.0	A . . .	
D_3	14848	03,*02*	13648	*21*,22	. . .	......	11425	03,11,*15*	**5875.9**	. *1* . *1*	He
	14602	07,*06*	. . .	....	. . .	......	. . .	......	5888.6	A . . .	

The reduction of the measures to wave lengths was made under the supervision of Mr. E. S. King. X 8729, an isochromatic plate of α Scorpii, taken on July 20, 1897, with an exposure of 64^m, with the same prisms as the plates named above, and showing the end of greater wave length, as far as the two D lines of sodium, was also measured. The wave lengths of numerous well marked lines in α Scorpii were ascertained by identification with known lines in the solar spectrum. By means of Hartmann's formula, wave lengths were computed, corresponding to the lines in α Scorpii, and residuals found by subtracting the known wave lengths of these lines from their computed values. The measures of the lines in α Crucis, θ Carinæ, and β Crucis, were then corrected by comparing them graphically with the measures of the lines in α Scorpii. Wave lengths of the lines, from 4812.2 to 5888.6, in α Crucis, θ Carinæ, and β Crucis, were next computed by the same formula that had already been used in the case of α Scorpii. The approximate wave lengths thus obtained were then corrected by means of the residual curve derived from the measures of α Scorpii as described above. The wave lengths thus found for Hβ, Hβ′, and D_3, must not be considered as independent determinations, since these lines were used as standards in deriving the formulas. The wave length of Hβ′ was assumed to be 5413.6, a provisional value derived by Mr. King. In order to apply Hartmann's formula to determine the wave lengths of the less refrangible lines, it was important to use a known line whose wave length was greater than that of Hβ′. Otherwise, extrapolation would be necessary. Such a line occurs in stars of the Orion type, and has been found to be identical with the helium line D_3. To determine its wave length, all the plates which show it distinctly, X 8739 of λ Scorpii, X 8997 of α Crucis, X 9186 of β Crucis, X 9201 of α Muscæ, and X 9199 of β Centauri, were in turn superposed on X 8729 of α Scorpii, which shows the double sodium line, D. In each case, the dark line in the Orion spectra was seen to have somewhat shorter wave length than the component, 5890.0, of the D line in α Scorpii. This was also the case when the five plates above named were superposed on the spectrum of α Tucanæ on X 8946, and on the spectrum of ε Scorpii on X 8735, both of which show the double D line of sodium. For an approximate determination of the wave length of the Orion line, the spectrum of β Centauri on X 9199 was superposed on the spectrum of α Scorpii on X 8729, so that the line Hβ in both spectra coincided. The two plates were firmly clamped together and the double image thus formed was treated as a single spectrum. The Orion line in β Centauri was then seen to fall between the solar lines 5857.8 and 5890.0 in α Scorpii. Measures were made of the intervals between the dark Orion line and the lines 5857.8, 5890.0, and 5896.0, using a two inch eye piece having a scale divided to fifths of a millimetre in its focus. Interpolating between the measures of the Orion line from lines 5857.8 and 5890.0, gave the wave length 5879.1 for the Orion line. Interpolating likewise between the measures of the Orion line from lines 5857.8 and 5896.0, gave the wave length 5879.0 for the Orion line. The close approach of the wave length thus obtained by these necessarily rough measures to the wave length of the helium line D_3, 5875.9, makes it hardly possible to doubt that this Orion line is the line D_3. Further evidence of the identity of this line comes from the fact that it is present in spectra where the helium lines, in general, are strongly marked, and has not been seen on isochromatic plates of spectra in which the helium lines are absent or very faint.

The brightest star of the fifth type, and the only one that can be photographed with a large dispersion, is γ Velorum. A special study has, therefore, been made of the wave lengths and intensities of the lines in its spectrum. Two isochromatic plates, X 8513, taken May 7, 1897, exposure 63^m, and X 10153, taken Dec. 2, 1899, exposure 78^m, were measured with the micrometer as described on page 240. These plates were both taken with two prisms, but the prisms were different, so that the dispersion of the latter plate is somewhat greater than that of the former.

The results of the investigation are given in Table XXVII. The first column contains the designations of the lines due to hydrogen. The second and third columns give the means of the two micrometer readings of X 8513 and X 10153, respectively. When the two edges of a band were measured, the results are placed on separate lines and connected with a brace. The fourth and fifth columns give the residuals from the means contained in the second and third columns, expressed in twenty-four thousandths of an inch, negative values being indicated by Italics. When a line was measured only once, the letter A takes the place of the residual. The sixth and seventh columns give the wave lengths corresponding to the measures of X 8513 and X 10153, respectively. The wave lengths of known lines are placed in heavy face type. The other lines are given as computed by Hartmann's formula, and corrected by a residual curve formed by taking the differences between the computed and known values of the hydrogen, and a few Orion, lines. In applying Hartmann's formula, Hζ, Hγ, and Hβ were used as standards for lines of shorter wave length than Hβ, measured on X 8513, and Hϵ, Hγ, and Hβ, for similar lines on X 10153. Hϵ, Hβ, and Hβ' were used as standards for lines of greater wave length than Hβ on both plates. By comparison with spectra of α Scorpii, ϵ Scorpii, and δ Canis Majoris, taken with the same dispersion as X 10153, the error at wave length 5780 was found to be -2.3, -0.4, and $+2.0$. A similar comparison made between X 8513 and X 8936, β Columbæ, showed an error of + 7.1 at this point. The definition of the lines in this region is much inferior on both of the latter plates to that of X 10153. On the other hand, on X 10153, owing to chromatic aberration, the lines and bands are so broad, from Hδ towards the violet, that all detail is lost, and neither measures nor estimates of intensity could safely be made for lines of shorter wave length than Hε.

The eighth and ninth columns contain residuals which, when applied to the known wave lengths, give the wave lengths computed by the formula and corrected by the residual curves. The tenth and eleventh columns give the intensities of the lines and bands as estimated on X 8513 and X 10153, respectively, except for lines of shorter wave length than Hζ, which were estimated on X 6266 taken Dec. 18, 1894, with one prism, exposure 30^m, and for line 4922.1, which was estimated on X 8514, taken May 7, 1897, exposure 30^m. These two plates are not isochromatic. The lines are referred to, in the remarks following the table, by the wave lengths given in the sixth column, except in cases where the line was measured on X 10153 only, when the wave length is that given in the seventh column.

TABLE XXVII.

LINES IN THE SPECTRUM OF γ VELORUM.

Des.	X 8513	X 10153	Resid.		Resid.		λ	λ	Res.	Res.	Int.	Int.
Hλ	....	....	..	..	..	..	**3734.2**	....	.	.	8	.
Hκ	....	....	..	..	..	..	**3750.2**	....	.	.	10	.
Hι	....	....	..	..	..	..	**3770.8**	....	.	.	12	.
Hθ	98191	....	*295*	295	..	..	**3798.1**	....	12	.	15	.
	96710	....	65	*66*	..	..	**3819.2**	....	9	.	10	.
Hη	95380	....	60	*61*	..	..	**3835.5**	....	8	.	15	.
	92238	....	*36*	35	..	..	3875.5	....	.	.	16	.
	91924	....	..	A	..	..	3879.5	....	.	.	*1*	.
	91443	....	..	A	..	..	3885.7	....	.	.		
Hζ	91144	....	*73*	72	..	..	**3889.1**	....	4	.	12	.
	91020	....	..	A	..	..	3891.0	....	.	.	*1*	.
	90401	....	*43*	43	..	..	3899.0	....	.	.		
	88316	....	*35*	34	..	..	3926.2	....	.	.	*3*	.
	87327	....	29	*29*	..	..	3939.4	....	.	.		
	86338	....	*92*	92	..	..	3952.8	....	.	.	*2*	.
	85283	....	*63*	63	..	..	3967.3	....	.	.		
Hε	85074	85074	*56*	57	*19*	19	**3970.2**	**3970.2**	*1*	*11*	10	8
	81163	....	*96*	96	..	..	**4026.4**	....	*2*	.	4	.
	80872	....	*122*	122	..	..	4030.6	....	.	.	*2*	.
	80606	....	..	A	..	..	4034.7	....	.	.		

Des.	X 8513	X 10153	Resid.		Resid.		λ	λ	Res.	Res.	Int.	Int.
	78888	78814	*54*	53	*125*	126	4061.1	4056.8	.	.	*5*	.
	77388	.. ..	*146*	146	..	..	4084.6	....	.	.		
	77118	.. ..	*47*	46	..	..	**4089.2**	....	*4*	.	3	.
	76899	.. ..	12	*12*	..	..	4092.1	....	.	.	*2*	.
	76465	.. ..	*99*	99	..	..	4098.0	....	.	.		
Hδ	76224	76063	*71*	71	54	*54*	**4101.8**	**4101.8**	*2*	*9*	10	12
	76086	.. ..	*62*	62	..	..	4103.8	....	.	.	*2*	.
	75455	.. ..	..	A	..	..	**4116.2**	....	*5*	.	2	.
	75433	.. ..	*156*	156	..	..	4116.1	....	.	.	*2*	.
	75294	.. ..	..	A	..	..	4117.9	....	.	.	*2*	.
	74505	73876	..	A	*183*	184	4131.1	4133.1	.	.		
	71728	.. ..	..	A	..	..	4177.0	....	.	.	*1*	.
	70455	.. ..	..	A	..	..	4198.7	....	.	.		
Hδ′	.. ..	69536	..	..	*29*	30	.. ..	**4200.7**	.	*5*	.	1
	69132	68545	..	A	A	..	4221.8	4216.6	.	.	*2*	*3*
	68157	67539	..	A	A	..	4239.1	4233.5	.	.		
	67359	66014	..	A	*08*	08	4253.5	4259.7	.	.	*4*	*5*
	65742	64754	..	A	*13*	14	4283.1	4281.8	.	.		
	64083	62881	*79*	79	136	*136*	4314.5	4315.3	.	.	*4*	*5*
	62934	61762	*69*	68	*13*	12	4336.7	4335.8	.	.		
Hγ	62755	61511	*63*	63	*17*	17	**4340.7**	**4340.7**	*5*	*2*	5	5
	62580	.. ..	..	A	..	..	4343.7	....	.	.	*2*	.
	62209	.. ..	..	A	..	..	4351.0	....	.	.		
	62034	.. ..	...	A	..	..	4354.5	....	.	.	1	.
	58077	56690	*22*	21	*05*	04	4436.3	4433.1	.	.	*5*	*5*
	57382	55826	*36*	36	*02*	01	4451.2	4450.3	.	.		
	57099	55588	..	A	*06*	07	4457.3	4455.1	.	.	5	3
	56896	.. ..	..	A	..	..	4461.8	....	.	.	*2*	.
	56645	.. ..	..	A	..	..	4467.3	....	.	.		
	56458	54762	*36*	36	04	03	**4471.8**	**4471.8**	*4*	1	5	3
	56290	.. ..	*34*	35	..	..	4475.2	....	.	.	*3*	.
	55800	.. ..	*99*	99	..	..	4486.3	....	.	.		
	55246	.. ..	*338*	337	..	..	4499.1	....	.	.	1	.
	54597	.. ..	..	A	..	..	**4514.5**	....	*4*	.	2	.
	....	52058	..	..	*57*	58	....	**4531.4**	.	6	.	2
Hγ′	53379	51418	*121*	121	08	*09*	**4542.4**	**4542.4**	*3*	3	2	2
	52936	.. ..	05	*04*	..	..	4552.4	....	.	.	*2*	.
	49526	.. ..	*53*	53	..	..	4634.8	....	.	.	3	.
	49372	.. ..	*55*	56	..	..	4638.6	....	.	.		
	49234	47308	*55*	55	*06*	07	4642.1	4636.5	.	.	*100*	*100*
	48123	45966	*32*	32	00	00	4670.2	4668.7	.	.		
	47649	45564	*67*	67	02	*02*	4682.4	4678.5	.	.	*20*	*30*
	46958	44800	*36*	35	12	*12*	4700.4	4697.2	.	.		
	43921	41601	*62*	63	..	A	4782.5	4778.8	.	.	*2*	*2*
	43320	41219	*02*	01	89	*88*	4799.4	4788.9	.	.		

Des.	X 8513	X 10153	Resid.		Resid.		λ	λ	Res.	Res.	Int.	Int.
	41525	38849	*51*	51	*21*	21	4850.8	4852.9	.	.	*2*	*2*
	41259	. . . .	*40*	40	. .	. .	4858.6	. . . .	.	.		
Hβ	41160	38504	*56*	57	12	*11*	**4861.5**	**4861.5**	0	5	3	6
	41036	. . . .	*26*	27	. .	. .	4865.2	. . . .	.	.	*2*	*2*
	40666	38209	*24*	25	*10*	10	4876.2	4870.3	.	.		
	. . . .	. . . .	. .	. .	. .	. .	4922.1	. . . .	.	.	3	.
	35917	. . . .	. .	A	. .	. .	5025.2	. . . .	.	.	*1*	.
	33520	30410	*45*	46	*47*	47	5106.5	5106.9	.	.	2	1
	25746	22186	*15*	15	09	*09*	5403.7	5402.8	.	.	.	*2*
Hβ′	. . . .	21918	. .	. .	18	*19*	. . . .	**5413.6**	.	*2*	*4*	3
	25278	21644	*53*	52	12	*13*	5423.5	5424.3	.	.	.	*2*
	24498	20666	*63*	62	*48*	48	5456.9	5464.1	.	.	*4*	*4*
	23980	20278	*12*	11	39	*40*	5479.4	5480.1	.	.		
	. . . .	17878	. .	. .	02	*01*	. . . .	5582.2	.	.	.	*1*
	. . . .	17614	. .	. .	09	*10*	. . . .	5593.8	.	.	.	2
	. . . .	17315	. .	. .	27	*27*	. . . .	5607.0	.	.	.	*1*
	19952	15822	*43*	43	*03*	04	5665.2	5674.5	.	.	*70*	*60*
	18975	14962	*73*	73	14	*15*	5713.3	5714.6	.	.		
	. . . .	13555	. .	. .	*29*	29	. . . .	5782.1	.	.	.	3
	. . . .	13248	. .	. .	. .	A	. . . .	5797.2	.	.	.	3
	17522	13193	*45*	45	*10*	10	5787.2	5799.9	.	.	*10*	*10*
	16905	12760	*76*	76	*18*	19	5819.5	5821.3	.	.		

REMARKS.

3875.5. This conspicuous, wide, dark band near Hζ has not been found in any other spectrum examined for this classification. It resembles Hζ, but is slightly more intense.

3879.5 to 3885.7. A faint, bright band on the edge of shorter wave length of Hζ.

3891.0 to 3899.0. A faint, bright band on the edge of greater wave length of Hζ.

3926.2 to 3939.4. A bright band covering the position of the line K. It appears uncertain whether this is a reversal of the calcium line, or a bright band on the edge of shorter wave length of an indistinct dark line, K.

3952.8 to 3967.3. A bright band on the edge of shorter wave length of Hε.

4030.6 to 4034.7. A bright band on the edge of greater wave length of the line 4026.4.

4092.1 to 4098.0. A bright band between line 4089.2 and Hδ, or it may be described as a bright band on the edge of shorter wave length of Hδ.

4103.8 to 4116.1. A bright band on the edge of greater wave length of Hδ. The dark Orion line 4116.2 appears on the edge of greater wave length of the bright band.

4200.7. This additional hydrogen line is ill defined on X 8513, and was not measured with the micrometer. It is, however, seen to be present, and dark on the latter plate, by superposition upon the spectrum of ζ Puppis.

4314.5 to 4336.7. A wide, bright band on the edge of shorter wave length of Hγ.

4343.7 to 4351.0. A faint, bright band on the edge of greater wave length of Hγ.

4436.3 to 4451.2. A conspicuous, bright band on the edge of shorter wave length of the dark line 4457.3.

4457.3. This dark line is not present in any other spectrum examined for this classification. It is wider than the adjacent helium line 4471.8.

4634.8 to 4638.6. This dark line is on the edge of shorter wave length of the intensely bright band 4642.1 to 4670.2.

4682.4 to 4700.4. A narrow dark line is superposed on this bright band on Plate X 10153.

4850.8 to 4858.6. The edge of shorter wave length of the bright band upon which the dark line, Hβ, is superposed.

4865.2 to 4876.2. The edge of greater wave length of the bright band upon which the dark line, Hβ, is superposed.

4922.1. Not measured owing to faintness of the image on isochromatic plates at this point. The line is, however, distinctly seen on ordinary plates, and readily identified by superposition upon spectra of the Orion type. The edge of greater wave length is slightly bright.

5025.2. Owing to the absorption of rays in this region on isochromatic plates, this bright line or band is photographed more distinctly on ordinary plates. On the latter plates, this bright band covers the position of the parhelium line 5015.7, seen in Orion spectra, and there is a dark line on the edge of shorter wave length of the bright band. The dark line has the approximate wave length 4999.

5413.6. This additional hydrogen line, Hβ′, presents on X 10153, a similar appearance to Hβ. A distinct dark line is superposed on a bright band. The dark line coincides with Hβ′ in ζ Puppis, when the two spectra are superposed. On X 8513, the bright band shows no dark line crossing it, and it is not certain whether this is due to the difference in exposure of the two plates, or to a change in the star.

5582.2 to 5607.0. A bright band on which a distinct dark line, 5593.8, is superposed. This band was measured only on X 10153. The appearance is similar to that of Hβ and Hβ′ on this plate. On X 8513, a faint bright band is present, but no reversal is seen.

5665.2 to 5713.3. On X 10153 this bright band has a faint, dark line superposed.

5782.1 and 5797.2. These two dark lines are situated on the edge of shorter wave length of the bright band, 5787.2 to 5819.5.

The general characteristics of the spectrum of γ Velorum may be stated as follows: —

The dark lines show little contrast to the continuous spectrum, except towards the end of shorter wave length, where the lines of hydrogen are much more intense than those of greater wave length. The two series of hydrogen lines are present. Plates taken with one prism show the first series of hydrogen lines from Hβ to Hλ, inclusive. The space between Hκ and Hι appears like a bright band. Hν and Hμ have not been seen, but two wide dark bands of still shorter wave length than Hν are indistinctly seen. The approximate centres of these bands are 3683 and 3704, respectively. The dark line Hβ is superposed on a bright band. This combination of a dark and bright line is directly opposite to that seen in many of the spectra of the Orion type, in which Hβ is bright and superposed on a dark band. Hγ has a wide, well marked bright band on the edge of shorter wave length, and a narrow bright band on the edge of greater wave length. Fainter bright bands are visible on both edges of the hydrogen lines, Hζ, Hε, and Hδ. Three lines, Hδ′, Hγ′, and Hβ′, of the additional series of hydrogen, are present. Hε′, if present, is not separated from the helium line 4026.4. On X 10153, Hβ′ presents a similar appearance to Hβ, being dark and superposed on a bright band. On this same plate the bright bands, 4682.4 to 4700.4, 5582.2 to 5607.0, 5665.2 to 5713.3, are also reversed. All the photographs of the spectrum of this star were carefully examined for changes, but none were noted except the reversals refered to above, and that Hζ was unusually faint on X 7505. Hδ′ and Hγ′ are dark. In some cases the bright edges of the dark lines are well marked, in others the brightness is not sharply enough defined to determine whether the effect is due to bright spaces in the continuous spectrum, or to actual bright edges of the lines. The Orion lines, in general, are faint and ill defined. The helium lines, 3819.2, 4026.4 and 4471.8 are well marked, as are also the unknown lines, 3875.5 and 4457.3, which have not been found in any other spectrum.

The bright bands in this spectrum are wide and most of them have hazy edges. As photographed on an isochromatic plate, two similar pairs of bright bands form the most conspicuous feature of the spectrum. The wave lengths of the centres of the first pair of these bands are 4656 and 4691, respectively. The other pair, fainter and wider apart, are at the extreme end of greater wave length, and have centres at 5689 and 5803, respectively. The band 4691 appears to be the same as that present in the spectra of classes Ob, Oc, Od, and Oe, for which the approximate wave length 4688 has been given. The band 4656 has a greater wave length than the bright band 4606 in spectra of class Ob, or the bright band 4633 in spectra of classes Oc, Od, and Oe. A few other bright bands are well marked, as may be seen from the intensities given in the preceding table. Some of the bright bands, however, are very faint, and may be spaces between faint, dark lines, or bands on which indistinct, dark lines are superposed.

Measures of the bright bands in H.P. 1311, A.G.C. 8631, are given in Table XXVIII. The plate used was X 4512, taken with one prism, on December 18, 1892, with an exposure of 64 minutes. The first column gives the designation of the hydrogen lines with which the bands are assumed to be identical. The second and

TABLE XXVIII.

MEASURES OF THE BANDS IN H.P. 1311, A.G.C. 8631.

Desig.	Measure.	Resid.			Wave length.	Desig.	Measure.	Resid.			Wave length.
	47911	10	*36*	27	4049.2		35731	*15*	*05*	19	4527.9
	47605	*01*	*05*	07	4059.2	Hγ′	35343	*22*	*10*	33	4546.6
	47337	*20*	*01*	20	4068.0		35199	32	03	*36*	4553.7
	46683	*33*	06	28	4089.6		34522	*22*	*07*	28	4587.5
Hδ	46041	03	*02*	*02*	4111.5		34117	01	*18*	18	4608.3
	45616	*26*	*15*	42	4126.1		33788	*08*	15	*06*	4625.5
Hδ′	43677	03	*22*	18	4195.4		33255	03	*22*	19	4654.0
	43205	*06*	22	*15*	4212.8		32658	*04*	*02*	06	4687.3
Hγ	40156	*21*	*13*	33	4340.7		32256	*08*	*07*	15	4710.4
	39736	05	*21*	17			30125	*40*	10	30	4844.8
						Hβ	29691	*04*	*24*	29	4875.5
							29545	*09*	*13*	23	4886.1

third columns give the mean of three measures made with the micrometer, and the corresponding residuals. Both edges of each band were measured. As has been stated on page 147, several of these bands appear to be double, or to have a dark line superposed. When this effect was seen under the micrometer, the dark line was also measured. The band near 4059 is double, the portion of shorter wave length being wider and much fainter than the other. The fourth column gives the wave lengths corresponding to these measures. Estimates of the intensities of these bands are given in Table XXII.

CHAPTER XVI.

MISCELLANEOUS.

Table XXIX contains an index to all stars in Parts I and II, which have letters assigned to them. The constellations are arranged in alphabetical order. The letter designating the star is followed by the class of spectrum according to the notation of Part II. The class of spectrum is followed by the H. P. number of the star taken from the first column of Table XII, for stars occurring in Part I, and the number from the first column of Table XVII, for stars occurring in Part II. When the same star has been classified in both Parts, it occupies two lines in the index, the first line referring to Part I, and the second line to Part II. Numbers taken from Part I are printed in Italics. The notation of the spectra in Part I was changed to that of Part II by means of Table XV, and not by an examination of the photographs, except in the cases of π Aquarii, γ Cassiopeiæ, P Cygni, β Lyræ, ϕ Persei, and υ Sagittarii. The peculiarities of some of these spectra are so marked that it is difficult to classify them by means of a simple notation. An attempt has been made to give the class whose typical star each spectrum most nearly resembles. The peculiarities of these spectra are fully discussed in the Remarks following Table XI. In the case of υ Sagittarii, the photographs examined show that the line Hβ is variable in this spectrum. This line has already been found to be variable in the spectra of A. G. C. 9181, J Velorum, κ^1 Apodis, and η Centauri, classified in Part II. The phenomenon presented in the spectrum of υ Sagittarii resembles in some respects that seen in η Centauri. On one plate of υ Sagittarii, Hβ is a faint bright line, on one plate, it is a faint dark line, on four plates, a well defined dark line, and on two plates, Hβ appears to be entirely absent.

The abbreviations Comp. and Pec. are used in the Index, as in Part II, to indicate Composite and Peculiar, respectively. Seven stars appear in two constellations in the table, since the designations are different in Part I, which follows the notation of Bayer and Heis, and Part II, which follows the notation of Lacaille and Gould. κ Argus in Part I is k Puppis in Part II; τ Argus is l Puppis; ξ Argus is ξ Puppis; e Argus is j Puppis; ι Argus is ρ Puppis; γ Scorpii is σ Libræ, and o Scorpii is τ Libræ. The designation o Scorpii is applied to H. P. 2601 in Part I, and to H. P. 2737 in Part II. H. P. 1370 is — Canis Majoris in Part I, and ω Canis Majoris in Part II. H. P. 2595 is — Scorpii in Part I, and υ Libræ in Part II.

TABLE XXIX.

INDEX TO LETTERS.

Andromeda.		
α	A Pec.	*5*
“	“ “	1
β	Ma	*185*
γ	K Comp.	*324*
δ	K	*92*
ζ	K	*119*
λ	K	*4174*
μ	A 2 F	*148*
ο	B 5 A Comp.	*4073*
Antlia.		
α	K 5 M	470
δ	B 9 A	474
ε	K 2 M	438
ι	K	532
Apus.		
α	K 5 M	721
β	K	833
γ	K	826
δ^1	Mb	816
δ^2	K 5 M	817
ζ	K 2 M	860
θ	Mb	686
κ^1	*B 5 A* Pec.	776
κ^2	B 8 A	784
Aquarius.		
α	G	*3899*
β	G	*3795*
γ	A	*3950*
δ	A 2 F	*4047*
ε	A	*3647*
ζ	F 5 G	*3970*
η	B 8 A	*3994*
λ	Ma	*4040*
π	*B 1 A*	*3960*
τ	K 5 M	*4031*
b^1	K	*4139*
“	“	1101
b^2	K 5 M	*4145*
b^2	K 5 M	1102
b^3	A	1106
c^1	G 5 K	1094
c^2	K	*4093*
“	“	1095
c^3	G Comp.	1097
Aquila.		
α	A 5 F	*3429*
“	“	987
β	K	*3450*
γ	K 2 M	*3418*
δ	F	*3343*
ζ	A	*3259*
η	G	*3436*
θ	A	*3514*
λ	A	*3260*
Ara.		
α	*B 3 A*	877
β	K 2 M	866
γ	B 1 A	867
δ	B 8 A	874
ϵ^1	K 2 M	854
ϵ^2	F 8 G	856
ζ	K 5 M	853
η	K 5 M	839
θ	B 1 A	897
λ	F 5 G	884
σ	A	880
Argo.		
ι	F 5 G	*1515*
κ	B 2 A	*1445*
ξ	G Pec.	*1474*
τ	A	*1462*
e	G	*1492*
Aries.		
α	K	*333*
“	K 2 M	48
β	A 5 F	*295*
γ	A Pec.	*291*
κ	A	*332*
Auriga.		
α	G	*932*
“	“	125
β	A	*1100*
“	A Pec.	174
δ	K	*1093*
ε	F 5 G Pec.	*877*
ζ	K Comp.	*879*
η	B 3 A	*896*
θ	A Pec.	*1104*
ι	K 2 M	*862*
π	Ma	*1102*
υ	Ma	*1072*
χ	B 1 A	*1001*
Boötes.		
α	K	*2400*
“	“	697
β	G 5 K	*2515*
γ	F	*2436*
δ	K	*2541*
ε	K Comp.	*2467*
η	G	*2360*
θ	F 8 G	*2426*
ρ	K	*2433*
σ	F	*2442*
υ	K 5 M	*2343*
Cælum.		
α	F 2 G	115
β	F 5 G	116
γ	K	120
δ	B 3 A	109
Cancer.		
β	K 2 M	*1533*
ζ	F 8 G	*1521*
ι	G 5 K	*1605*
Canis Major.		
α	A	*1275*
“	“	205
β	B 1 A	*1201*
γ	B 5 A	*1340*
δ	F 8 G Pec.	*1350*
“	“ “	233
ε	B 1 A	*1325*
“	“	227
ζ	B 3 A	*1195*
“	“	189
η	B 5 A Pec.	*1399*
“	“ “	269
κ	*B 2 A*	208
λ	B 5 A	194
ξ^1	B 1 A	196
ξ^2	A	199
o^1	G 5 K	*1312*
“	K 2 M	219
o^2	B 5 A Pec.	*1337*
“	“ “	231
π	F 5 G	222
σ	K 5 M	230
τ	Oe 5 B	261
ω	*B 3 A*	248
Canis Minor.		
α	F 5 G	*1442*
“	“	283
β	B 8 A	*1403*
Capricornus.		
α^1	G	*3537*
α^2	K	*3538*
β	G Comp.	*3554*
γ	F Comp.	*3818*
δ	A 5 F	*3848*
ε	B 5 A Pec.	1047
ζ	G 5 K Pec.	*3779*
“	G Pec.	1043
η	A 3 F	1034
ν	A	*3552*

ψ	F 8 G	1018
ω	Ma	1027
b	G 5 K	1044
A	Ma	1036

CARINA.

α	F	193
β	A	425
ε	K Comp.	370
η	Q	512
θ	B	504
ι	F	429
υ	F	449
χ	B 3 A	321
ω	B 8 A	461
a	B 3 A	417
b^1	B 3 A	403
b^2	F	406
c	B 8 A	401
d	B 2 A	386
e^1	B 3 A	377
e^2	K	376
f	B 3 A	395
g	Ma	428
h	B 5 A	444
i	B 3 A	418
k	K	433
l	G	448
m	B 9 A	447
p	*B 5 A*	477
q	K 5 M	462
r	K 5 M	481
s	F	473
t^1	K	484
t^2	K 5 M	489
u	K	528
w	K 5 M	505
x	F 8 G Pec.	544
y	F 5 G Pec.	551
z	K	542
A	G 5 K	213
B	F 5 G	350
D	B 3 A	336
E	*B 3 A*	414
G	F 5 G	415
I	F 5 G	469
K	A 2 F	476
N	A	201
Q	K 5 M	281
R	Md	442
S	Md	458
T	K	530

CASSIOPEIA.

α	K	*94*
β	F 5 G	*9*
γ	*B* Pec.	*142*
δ	A 5 F	*219*
ε	B 3 A	*287*
ζ	B 2 A	*82*
η	F 8 G	*120*
κ	B	*71*
λ	B 5 A	*69*
ο	B 2 A	*107*
ρ	F 8 G Pec.	*4224*
A	A 2 F	*304*
R	Md	*4234*

CENTAURUS.

a^1	G	716
a^2	K 5 M	717
β	B 1 A	687
γ	A	619
δ	*B 3 A*	589
ε	B 1 A	663
ζ	B 2 A Pec.	678
η	*B 3 A* Comp.	714
θ	K	692
ι	A 2 F	654
κ	B 3 A	736
λ	B 9 A	562
μ	*B 2 A*	672
ν	B 2 A	670
ξ^1	A	640
ξ^2	B 3 A	642
o^1	F 8 G Pec.	556
o^2	A 2 F Pec.	557
π	B 5 A	558
ρ	B 3 A	593
σ	B 3 A	609
τ	A 2 F	617
υ^1	B 3 A	683
υ^2	F 5 G	685
φ	B 3 A	682
χ	B 3 A	690
ψ	A	701
a	B 5 A	703
b	B 3 A	722
c^1	K	724
c^2	A	725
d	K	662
e	K 2 M	632
f	B 3 A	641
g	Mb	671
h	B 5 A	676
i	F 5 G	666
j	B 5 A	576
k	B 5 A	674
l	B 8 A	618
m	G	657
n	A 5 F	633
v	B 5 A	699
w	K	621
A	B 8 A	561
B	K	578
F	Ma	599
G	B 3 A	605
J	B 5 A	656
M	K	667

CEPHEUS.

α	A 5 F	*3757*
β	B 1 A	*3798*
γ	K	*4182*
δ	G	*3981*
ε	A 5 F	*3942*
ζ	K	*3923*
η	K	*3656*
ι	K	*4037*
μ	Ma	*3845*

CETUS.

α	Ma	*482*
“	“	68
β	K	*103*
γ	A	*433*
δ	B 2 A	*418*
η	K	*183*
θ	K	*220*
ι	K	*45*
μ	A 5 F	*437*
ο	Md	*370*
υ	K 5 M	*315*
“	Ma	41

CHAMÆLEON.

α	F 5 G	371
β	B 5 A	597
γ	Ma	488
δ^1	K	521
δ^2	B 3 A	523
ε	B 9 A	583
θ	K	372
κ	K 5 M	586

CIRCINUS.

α	F	718
β	A 3 F	755
γ	B 5 A Comp.	769
δ	Oe 5 B	752
ε	K	753

COLUMBA.

α	*B 5 A*	162
β	K	167
γ	B 3 A	178
δ	G 5 K	191
ε	K	138
η	K	179
κ	K	187
λ	B 5 A	171
ξ	K	174
ο	K	128

CORONA AUST.

α	A 2 F	969
β	G 5 K	972
γ	F 8 G	965
δ	K	968
ε	F 5 G	957
ζ	A	960
θ	G 5 K	936

CORONA BOR.

α	A	*2594*
β	F Pec.	*2572*
γ	A	*2625*
ε	K	*2673*

CORVUS.

α	F 2 G	590
β	G 5 K	*2134*
“	“	614
γ	B 8 A	*2078*
δ	A	*2120*
ε	K	*2063*
“	“	591
η	F	*2128*

CRATER.

α	K	*1918*
β	A 2 F	549
γ	A 2 F	*1973*
δ	K	*1963*

CRUX.

α^1	B 1 A	606
α^2		607
β	B 1 A	626
γ	Mb	611
δ	B 3 A	595
ε	K 2 M	600
ζ	B 3 A	598
η	F	587
θ^1	A 5 F	584
θ^2	B 3 A	585
ι	K	623
λ	B 3 A	634
μ	B 3 A	636

CYGNUS.

α	A 2 F Pec	*3631*
“	“ “	1017
β	K Comp.	*3362*
γ	F 8 G Pec.	*3564*
δ	A	*3419*
ε	K	*3648*
ζ	K	*3732*
η	K	*3460*
θ	F 5 G	*3393*
ι	A 2 F	*3365*
κ	K	*3316*
ξ	K 5 M	*3716*
o^1	A 2 F	*3527*
	K Comp.	*3528*
o^2	G 5 K	*3541*
ρ	K	*3807*
τ	F	*3741*
υ	*B 3 A*	*3747*
χ	Md Pec.	*3434*
A	Oe 5 B	*3750*
P	*B 1 A* Pec.	*3547*
T	K	*3654*

DELPHINUS.

α	B 8 A	*3624*
β	F 5 G	*3605*
γ	G 5 K	*3645*
δ	A 2 F	*3635*
ε	B 5 A	*3592*
ζ	A	*3600*

DORADO.

α	A Pec.	113
β	F 5 G	157
γ	F 5 G	104
δ	A 5 F	164
ε	B 5 A	173
ζ	F 8 G	124
η^2	Mb	186
θ	K	129
ν	B 9 A	185

DRACO.

α	A	*2381*
β	G	*2937*
γ	K 5 M	*3009*
δ	K	*3307*
ε	K	*3447*
ζ	B 5 A	*2878*
θ	F 8 G	*2696*
ι	K	*2569*
κ	*B 5 A*	*2135*
λ	Ma	*1988*
ξ	K	*3003*
τ	K	*3328*
φ	A Pec.	*3120*
χ	F 8 G	*3122*
d	F 8 G Pec.	*3136*
e	Ma	*3498*
i	Ma	*2356*

EQUULEUS.

α	F 8 G Comp.	*3739*

ERIDANUS.

α	B 5 A	32
β	A 2 F	*910*
γ	K 5 M	*653*
ε	K Pec.	*576*
η	K	*464*
θ	A 2 F	66
ι	K	57
κ	B 5 A	51
ν	B 2 A	*799*
o^1	F 5 G	*701*
τ^2	K	63
τ^3	A 2 F	*487*
“	A 3 F	69
τ^4	Mb	*533*
“	“	72
τ^5	B 8 A	*579*
“	“	76
τ^6	F 8 G	85
τ^7	A 2 F	89
τ^8	B 5 A	96
τ^9	A Pec.	97
υ^1	K	110
υ^2	K	112
φ	B 8 A	49
χ	G 5 K	36
ω	A 5 F	*854*
c	A 5 F	*806*
d	K 5 M	107
e	G 5 K	78
f	A	91
	B 8 A	92
g	K	93
h	K 2 M	80
s	A	55
y	K	77
X	B 9 A	105

FORNAX.

α	F 8 G	70
β	K	62
δ	B 5 A	78
ν	A Pec.	47
π	G 5 K	44
φ	A 2 F	52
ω	B 9 A	53

GEMINI.

α	A	*1423*
“	“	276
β	K	*1459*
“	“	292
γ	A	*1249*
δ	F	*1377*
ε	G 5 K	*1263*
ζ	G	*1334*
η	Ma	*1160*
θ	A 2 F	*1295*
ι	K	*1394*
κ	G 5 K	*1457*
λ	A 2 F	*1373*
μ	Ma	*1194*
ξ	F 5 G	*1272*
ρ	F	*1405*
σ	K	*1453*
υ	K 5 M	*1430*

GRUS.

α	B 5 A	1057
β	Mb	1083
γ	B 8 A	1051
δ^1	G 5 K	1072
δ^2	Mb	1073
ε	A 2 F	1087
ζ	G 5 K	1092
η	K	1085
θ	F 5 G	1093
ι	K	1098
λ	K 2 M	1056
μ^1	G	1064
μ^2	G 5 K	1065
ρ	K	1084

HERCULES.

α	Mb	*2879*
β	K	*2774*
γ	F	*2747*
δ	A	*2880*
ε	A	*2844*
ζ	G	*2807*

η	K	*2810*
ι	B 3 A	*2959*
μ	G 5 K	*2976*
ν	F	*3010*
ξ	K	*3007*
ο	A	*3048*
π	K 2 M	*2885*
ρ	A	*2914*
σ	A	*2787*
τ	B 5 A	*2745*
φ	A	*2713*
b	F 8 G	*3047*
e	A	*2893*
g	Mb	*2772*
u	B 3 A	*2890*
A	Ma	*3065*

Horologium.

α	K	102
β	A 5 F	67
δ	F	101

Hydra.

α	K 2 M	*1698*
β	B 9 A	579
γ	G 5 K	*2249*
“	“	652
δ	A	*1588*
ε	F 8 G	*1608*
ζ	K	*1629*
η	B 3 A	*1599*
θ	A	*1676*
ι	K	*1734*
λ	K	*1800*
μ	K 5 M	*1837*
ν	Ma	*1893*
ξ	G 5 K	560
ο	B 8 A	566
π	K	*2378*
“	“	691
ρ	A	*1613*
χ^1	F 5 G	537
χ^2	B 8 A	539
k	K 2 M	704
l	B 8 A	709
m	F 5 G	726
E	K 2 M	731
G	K	437
U	N	*1869*

Hydrus.

α	F	43
β	G	4
γ	Ma	95
δ	A 2 F	50
ε	B 9 A	58
ζ	A 2 F	61
η^2	K	37
λ	K 5 M	21
μ	K	54
ν	K 2 M	65

Indus.

α	K	1012
β	K	1028
δ	F	1052
ε	K 5 M	1054
ζ	K 5 M	1020
η	F	1016
θ	A 5 F	1039

Leo.

α	B 8 A	*1797*
“	“	457
β	A 2 F	*2025*
γ	K	*1823*
δ	A 2 F	*1949*
ε	G Pec.	*1747*
ζ	F	*1812*
η	A Pec.	*1793*
θ	A	*1951*
ι	F 5 G	*1969*
μ	K	*1760*
ο	F 5 G Comp.	*1740*
π	Ma	*1782*
ρ	B Pec.	*1859*
σ	A	*1965*
b	A	*1925*
R	Md	*1752*

Lepus.

α	F	*1014*
β	G	*994*
“	“	134
γ	F 8 G	*1057*
“	“	163
δ	K	*1086*
“	“	166
ε	K 5 M	*901*
“	“	122
ζ	A 2 F	*1065*
η	F 5 G	*1101*
μ	A Pec.	*929*

Libra.

α	A 2 F	*2480*
β	B 8 A	*2539*
γ	K	*2589*
δ	A	*2506*
σ	Mb	739
τ	B 3 A	788
υ	K 2 M	786

Lupus.

α	B 2 A	720
β	B 2 A Pec.	735
γ	B 3 A	782
δ	B 2 A	763
ε	B 3 A	772
ζ	K	748
η	B 3 A	803
θ	B 3 A	811
ι	B 3 A	698
κ	B 9 A	746
λ	B 3 A	744
μ	B 8 A	760
ν^1	F 8 G	766
ν^2	G	767
ξ	A	798
ο	B 5 A	732
π	B 5 A	740
ρ	B 5 A	715
σ	B 2 A	713
τ^1	B 3 A	706
τ^2	F 8 G	707
υ	A	774
ϕ^1	K 5 M	770
ϕ^2	B 3 A	773
χ	B 9 A	794
ψ^1	K	789
ψ^2	B 5 A	792
ω	K 5 M	787
d	B 3 A	783
e	B 3 A	749
f	K	761
g	F 5 G	791
k	A	775

Lyra.

α	A	*3147*
“	“	938
β	*B 2 A* Comp.	*3193*
γ	A	*3232*
δ^1	B 3 A	*3207*
δ^2	Mb	*3210*
η	B 3 A	*3291*
ν	A 2 F	*3192*
R	Mb	*3224*

Mensa.

γ	K	161

Microscopium.

α	K	1022
β	A 2 F	1026
γ	G 5 K	1033
ε	A	1038
θ^1	A 2 F Pec.	1040
θ^2	A Pec.	1041

Monoceros.

S	Oe 5 B	*1256*
T	G	*1205*

Musca.

α	B 3 A	616
β	B 3 A	624
γ	B 5 A	613
δ	K 2 M	638
ε	Mb	596
ζ^1	K	602
ζ^2	A 5 F	601
η	B 8 A	649
θ	Oa Pec.	648
ι^1	K	658
λ	A 5 F	572
μ	K 5 M	574

Norma.

γ^1	F 8 G	819
γ^2	K	820
δ	A 3 F Pec.	809
ε	B 5 A	827
η	G 5 K	806
ι^1	A 2 F	805
ι^2	A	814

Octans.

β	F	1082
δ	K 2 M	696
θ	K	1120
ν	K	1046
π^1	K	730

Ophiuchus.

α	A 5 F	*2944*
β	K	*2962*
γ	A	*2979*
δ	Ma	*2726*
ε	K	*2736*
ζ	B	*2788*
η	A	*2868*
θ	B 3 A	*2899*
“	“	864
κ	K	*2838*
λ	A	*2773*
ν	K	*3005*
ξ	F 5 G	862
ω	F	832
b	F	870
c	A	878
d	F 5 G	872

Orion.

α	Ma	*1091*
“	“	172
β	B 8 A Pec.	*936*
“	“ “	126
γ	B 2 A	979
“	“	133
δ	B	*1005*
“	“	136
ε	B	*1029*
“	“	152
ζ	B	*1045*
“	“	159
η	B 1 A	*975*
θ^1	Oe 5 B	*1023*
“	“	143
θ^2	B 2 A	*1024*
“	B 1 A	147
ι	Oe 5 B	*1027*
“	“	150
κ	B	*1068*
λ	Oe 5 B	*1019*
ν	B 2 A	*1132*
ξ	B 2 A	*1153*
o^1	Ma	*850*
π^3	F 8 G	*840*
π^4	B 3 A	*845*
“	“	118
π^5	B 3 A	*857*
σ	B	*1039*
τ	B 5 A	*948*
ϕ^1	B	*1017*
ϕ^2	K	*1030*
χ^1	F 8 G	*1089*
χ^2	B 2 A	*1122*
c	B 1 A	*1025*
“	B 3 A	146
“	F	*1026*
“	F	151
U	Md	—

Pavo.

α	B 3 A	1009
β	A 5 F	1015
γ	F 8 G	1042
δ	G 5 K	1007
ε	A	990
ζ	K	937
η	K	886
θ	A 3 F	944
κ	F 5 G	947
λ	B 2 A	946
μ^1	K	992
μ^2	K	995
ν	B 8 A	929
ξ	K 2 M	917
π	A 5 F	898
ρ	F 5 G	1011
υ	B 9 A	1014
ϕ^1	F	1010
ϕ^2	F 8 G	1013

Pegasus.

α	A	*4080*
β	Ma	*4078*
γ	B 2 A	*23*
ε	K	*3836*
ζ	B 8 A	*4013*
η	G	*4020*
θ	A	*3913*
ι	F 5 G	*3907*
κ	F 5 G	*3843*
λ	K	*4026*
μ	K	*4034*
ξ	F 5 G	*4024*
o	A	*4015*
φ	Ma	*4217*

Perseus.

α	F 5 G	*541*
“	“	74
β	B 8 A	*496*
γ	G Comp.	*483*
δ	B 5 A	*591*
ε	B	*649*
ζ	B 1 A	*638*
η	K	*443*
θ	G	*429*
κ	K	*498*
μ	G	*702*
ν	F 5 G	*602*
ξ	Oe 5 B	*652*
o	B 1 A	*600*
ρ	Mb	*489*
σ	K	*560*
τ	G Comp.	*454*
υ	K	*251*
φ	*B* Pec.	*269*
ψ	*B 5 A*	*578*

Phœnix.

α	K	5
β	K	25
γ	K 5 M	29
δ	K	31
ε	K	2
ζ	B 8 A	26
η	A	20
ι	A 2 F Pec.	1107
κ	A 3 F	6
λ^1	A 2 F	10
λ^2	F 8 G	15
μ	K	18
ν	G	27
ξ	F Pec.	19
π	K	1116
ρ	F 5 G	22
σ	B 5 A	1111
φ	B 9 A	34
χ	K	45
ψ	Mb	83

Pictor.

α	A 5 F	211
β	A 3 F	165
γ	K	168
δ	B 1 A	184
η^1	F 5 G	119
η^2	K 5 M	123

Piscis.

α	A 2 F Comp.	*320*
γ	K	*4114*
δ	K 5 M	*125*
η	G 5 K	*239*
ω	F 5 G	*4238*

Piscis Aust.

α	A 2 F	*4057*
“	A 3 F	1091
β	A	1074
γ	A	1089
δ	K	1090
ε	B 8 A	*4007*
“	“	1081
θ	A 2 F	1050
ι	A	1049
μ	A 2 F	1058
τ	F 8 G	1062
υ	K 5 M	1059

Puppis.

ζ	Od	339
ν	B 8 A	203
ξ	G	307
o	*B 2 A*	303
π	K 5 M	258
ρ	F 5 G	341
σ	K 5 M	273
τ	K	212
a	G 5 K	313
b	B 3 A	314
c	K 5 M	299
d^3	B 5 A	288
f	B 8 A	282
h^1	K 5 M	352
h^2	K	358
j	F 8 G	319
k	B 8 A	284
l	A 2 F Pec.	294
q	A 5 F	363
r	*B 3 A*	356
v^1	*B 3 A*	263
v^2	B 3 A	265
w	K	365
A	B 3 A	235
I	F	244
J	B 1 A	317
L^1	A Pec.	246
L^2	Md	247
P	B	309
Q	K	308

Pyxis.

α	B 2 A	390
β	G 5 K	379
γ	K 2 M	396
θ	Ma	431

Reticulum.

α	G 5 K	103
β	K	86
γ	Mb	99
δ	Ma	98
ε	K 2 M	106
ι	K 5 M	100
κ	F 5 G	75

Sagitta.

γ	K 5 M	*3466*
δ	Ma Comp.	*3421*
ζ	A	*3424*

Sagittarius.

α	B 8 A	977
β^1	B 8 A	975
β^2	F	976
γ	K	899
δ	K	*3084*
"	"	918
ε	A	922
ζ	A 2 F	961
η	Mb	913
θ^1	B 3 A	997
θ^2	A 3 F	998
ι	K	988
λ	K	927
μ	B 8 A Pec.	*3062*
"	" "	907
ν^1	G 5 K	948
ν^2	K	949
ξ^1	A	955
ξ^2	K	956
ο	K	*3252*
"	"	963
π	F	*3270*
"	F 2 G	973
ρ	A 5 F	*3319*
σ	B 3 A	*3199*
"	"	950
τ	K	967
υ	*B 8 A* Comp.	*3321*
φ	B 8 A	*3157*
"	"	945
ω	G 5 K	991
b	K 2 M	993
c	Mb	1002
f	K	985
h^1	A 3 F	981
h^2	B 9 A	982
A	G 5 K	996
W	F 5 G	896
X	F 8 G	888

Scorpius.

α	Ma Comp.	*2764*
"	" "	829
β	B 2 A	*2690*
"	B 1 A	810
γ	Ma	*2514*
δ	B 1 A Pec.	*2674*
"	B	804
ε	K	840
ζ^1	*B 1 A* Pec.	845
ζ^2	K 5 M	850
η	F 2 G	859
θ	F	883
ι^1	F 5 G Pec.	887
ι^2	A 2 F Pec.	892
κ	B 2 A	885
λ	B 2 A	879
μ^1	B 3 A Pec.	842
μ^2	B 2 A	844
ξ	F 8 G	*2688*
ο	B 2 A	*2601*
o	A 3 F	821
π	B 2 A	*2671*
"	B 2 A Pec.	802
ρ	B 3 A	*2662*
"	"	800
σ	B	*2738*
"	B 1 A	823
τ	B	*2783*
"	"	834
υ	B 3 A	876
ω^1	B 2 A	*2698*
"	"	813
ω^2	G	*2700*
"	"	815
b	B 3 A	795
k	B 1 A Pec.	857
A	B 3 A	797
G	K 2 M	891
H	Ma	835
N	B 3 A	831
Q	K	881

Sculptor.

α	B 5 A	23
β	B 9 A	1105
γ	K	1100
δ	A	1112
ζ	B 5 A	1121
η	Mb	7

Serpens.

α	K	*2627*
β	A 2 F	*2632*
γ	F 8 G	*2666*
ε	A	*2645*
η	K	*3090*
κ	K 5 M	*2636*
μ	A	*2638*
ξ	A 5 F	*2947*
τ^1	Ma	*2563*

Taurus.

α	K 5 M	*797*
"	"	111
β	B 8 A	*978*
δ	K	*750*
η	B 5 A	*618*
"	"	84
θ^1	K	*775*
θ^2	A 5 F	*776*
λ	B 3 A	*657*
ν	A	*665*
ξ	B 8 A	*554*
ο	G 5 K	*550*
q	B 5 A	*610*
"	"	81

Telescopium.

α	B 3 A	924
δ^1	B 8 A	934
δ^2	B 5 A	935
ε	K	904
ζ	K	925
ι	K	980
λ	B 9 A	954
ξ	Ma	1008

Triangulum.

α	F 5 G	*289*
β	A 5 F	*336*
γ	A	*361*
δ	G	*360*

	TRIANG. AUST.	
α	K 2 M	837
β	F	796
γ	A	756
δ	G	818
ε	K	780
ζ	G	825
	TUCANA.	
α	K 2 M	1066
β¹	B 9 A	11
β²	A 2 F	12
γ	F 2 G	1099
δ	B 9 A	1070
ε	B 9 A	1118
ζ	F 8 G	3
η	A 2 F	1114
θ	A 5 F	14
κ	F 8 G	28
ν	Mb	1075
	URSA MAJOR.	
α	K	*1926*
β	A	*1923*
γ	A	*2036*
δ	A 2 F	*2077*
ε	A Pec.	*2191*
ζ	A	*2264*
η	B 3 A	*2338*
θ	F 8 G	*1709*
ι	A 5 F	*1636*
κ	A	*1645*
λ	A	*1810*
μ	K 5 M	*1827*
ν	K	*1961*
ξ	G	*1959*
ο	G	*1558*
π¹	G 5 K	*1580*
π²	K	*1584*
ρ	Ma	*1638*
σ¹	K 5 M	*1651*
σ²	F 8 G	*1655*
τ	F 5 G Comp.	*1658*
υ	F	*1753*
χ	K	*2018*
ψ	K	*1941*
g	A 2 F	*2267*
h	F	*1701*
	URSA MINOR.	
α	F 8 G	*213*
β	K 5 M	*2500*
γ	A 2 F	*2566*
ε	G 5 K	*2851*
	VELA.	
γ	Oa Pec.	347
δ	A	392
κ	B 3 A	435
λ	K 5 M	413
μ	G 5 K	514
ο	B 3 A	383
φ	B 5 A	456
ψ	F 5 G	439
a	A	393
b	F 5 G Pec.	382
c	K	411
d	G 5 K	391
e	A 5 F	378
f	B	398
g	A 2 F	397
i	A 2 F	535
k	F 5 G	424
l	K	423
m	G 5 K	454
n	A 3 F	384
p	F 2 G	485
q	A 2 F	460
r	K 5 M	466
u	B 8 A	450
w	F 8 G	405
x	G	491
z	B 3 A	420
A	B 5 A	374
B	B 2 A	367
C	K	375
H	B 5 A	402
J	*B 5 A* Pec.	465
M	A 5 F	446
N	K 5 M	440
	VIRGO.	
α	B 2 A	*2263*
"	"	660
β	F 8 G	*2028*
γ	F	*2155*
δ	Ma	*2193*
ε	K	*2208*
ζ	A 2 F	*2294*
η	A	*2088*
μ	F 5 G	*2457*
ν	Ma	*2019*
ο	G 5 K	*2057*
	VOLANS.	
α	A 5 F	412
β	K	373
γ¹	G	242
γ²	K	243
δ	F 5 G	268
ε	B 5 A	351
ζ	K	302
κ¹	B 9 A	368
κ²	A	369

An examination of Tables XII and XVII shows that there are 98 stars common to Part I and Part II of this volume. In 71 of them, the classification of Part I, as translated into the notation of Part II by means of Table XV, agrees exactly with the classification of Part II, except that H.P. 1474, ξ Argus, is marked Pec. in Part I, and not in Part II, while the spectroscopic binaries, β Aurigæ and π Scorpii, are called Pec. in Part II, and not in Part I. The spectra of 20 of the stars common to Parts I and II, fall in the successive subdivisions of Part II. For instance, α Arietis is Class K according to Part I, and K 2 M, in Part II; and τ^3 Eridani is A 2 F according to Part I, and A 3 F in Part II. There are 7 stars that differ by more than one subdivision. They are enumerated in Table XXX, in which the first column gives the number of the star in the Harvard Photometry, the second column, the number taken from the first column of Table XVII of this volume, the third column, the classification of the spectrum obtained by changing the notation of Part I into that of Part II by means of Table XV, and the fourth column, the classification according to Part II.

TABLE XXX.

STARS WHOSE CLASSIFICATION IN PARTS I AND II DIFFER BY MORE THAN ONE SUBDIVISION.

H. P.	No. Part II.	Class. Part I.	Class. Part II.
1025	146	B 1 A	B 3 A
–	148	B 2 A	B 5 A
–	154	B 1 A	B 3 A
1312	219	G 5 K	K 2 M
1368	245	B 2 A	*B 5 A* Pec.
1445	284	B 2 A	B 8 A
	285		B 3 A
3069	911	B 9 A	B

These differences were then investigated by examining the plates taken with the 11-inch Draper telescope, used in classifying these spectra for Part I of this volume, together with the plates taken with the 13-inch Boyden telescope, used for Part II. The result of the examination is given below.

H. P. 1025. Image rather dense on Plate X 3881, from which the classification for Part II was made. Spectrum examined on Plate C 1664, and classified B 2 A.

No. 148, Part II. Image poor on Plate X 3881, and also on Plate C 1664. From the latter plate, the spectrum appears to belong to Class B 3 A.

No. 154, Part II. Image poor on Plate X 3881, and too poor on Plates C 1656 and C 1688 to determine the class with certainty. On Plate C 805 the spectrum appears to belong to Class B 3 A.

H. P. 1312. o^1 Canis Majoris. This spectrum is slightly peculiar in combining characteristics of both Classes G 5 K and K 2 M. See Remark 109, page 97, and Remark 203, page 189.

H. P. 1368. From a study of the X plates, this spectrum has been shown to have two variable bright lines, $H\gamma$ and $H\beta$. See Remark 101, p. 184. Plates C 1665 and C 2512, which were used in classifying the spectrum for Part I, are too poor to determine the class with precision. The line $H\beta$ shows a slight brightness on the edge of greater wave length on Plate C 2512, taken March 3, 1890. This bright line is so faint that it might be assumed to be a defect, were the nature of the spectrum unknown.

H. P. *1445*. The spectra of H. P. 1445 and 1446 are separated on the X plates, but not on the C plates.

H. P. 3069. The class of this spectrum is very clearly defined on two excellent photographs, X 5103 and X 5930. The uncertainty of the classification in Part I is explained in Remark 38, p. 95.

To illustrate the various types of stellar spectra, enlargements of several of the original negatives have been made by Mr. Edward S. King, and are shown in Plates I, II, and III. In Plates I and II a motion parallel to the lines in the spectrum is given to the negative, as first described in 1887, in the First Annual Report of the Henry Draper Memorial, page 5. Paper prints were made from these enlargements, and mounted so that the ends of the hydrogen line Hγ coincided in the adjacent spectra. The photo-engravings were made from these prints.

Owing to the various photographic processes employed, it appeared to be impossible to represent the relative intensity of different portions of the spectra. This difficulty was increased by the fact that some of the best photographs were taken on isochromatic plates. These plates although sensitive to the green and yellow rays, so that good photographs of this portion of the spectrum may be obtained, are less sensitive than ordinary plates to the rays in the vicinity of Hβ. If then, as in the accompanying illustrations, the portion of the spectrum between wave lengths 3800 and 5000 only is shown, stars photographed on isochromatic plates will appear of a bluer color than if they were photographed on ordinary plates, since the portion of the spectrum of greater wave length will appear relatively faint.

According to the notation adopted in the Draper Catalogue, Harvard Annals Vol. XXVII, the various types of spectra are designated by letters. If we select six typical spectra, B, A, F, G, K, and M, nearly all of the stars may be arranged in a continuous sequence in which each spectrum will be identical with one of these types, or will be intermediate between two of them. These spectra are reproduced in Plate I. The Class according to the Draper Catalogue, and the type according to Secchi are given in the left hand margin, and the name of the star in the right hand margin. A brief description of each spectrum is given below:—

B. I. ϵ Orionis. Enlarged from X 8119, an isochromatic plate, taken November 10, 1896, exposure 106^m. The region of Hβ appears fainter than on ordinary plates, owing to the absorption of rays of this wave length on isochromatic plates. Lines of shorter wave length than Hϵ are lost in the reproduction.

The helium line 4026.4, nearly mid-way between Hε and Hδ, appears more intense than in the original negative. The group of lines visible near Hδ includes, on the side of shorter wave length, the oxygen triplet, 4069.4, 4072.0 and 4075.9, lines 4089.2, and 4096.9; on the side of greater wave length, 4116.2, and the helium lines, 4120.5 and 4144.0. The three most intense lines between Hγ and Hβ are 4471.8, 4649.2 and 4712.8, the first and the last being due to helium.

For a detailed description of this spectrum, see pages 16 and 150.

A. I. α Canis Majoris. Enlarged from X 8094, taken October 28, 1896, exposure 60^m. This spectrum shows the maximum intensity of the lines of hydrogen. The narrow calcium line, K, line 4481.4, and numerous fainter lines are visible. The separation of the calcium line, H, from the hydrogen line, Hε, is not perceptible in this reproduction, although distinctly visible on the original negative. This spectrum is described on pages 23 and 154.

F. I–II. α Carinæ. Enlarged from X 8114, an isochromatic plate taken November 9, 1896, exposure 82^m. This spectrum is intermediate between Secchi's first and second types. The hydrogen lines are less intense and the calcium bands are much wider than in α Canis Majoris. A large number of solar lines are visible. As stated on page 263, 16 lines have been counted on the original negative, between K and H. This spectrum is described on page 156.

G. II. α Aurigæ. Enlarged from X 7984, taken September 11, 1896, exposure 98^m. The wide bands K and H, the band G, and numerous well marked solar lines are seen. This spectrum is described on pages 35 and 158.

K. II. α Boötis. Enlarged from C 6563, taken February 5, 1894, exposure 49^m. The bands K and H appear to reach a maximum in this spectrum. Line 4227.0 is greatly increased in intensity, while the hydrogen lines are very faint. The portion of the spectrum from Hγ to Hβ is brighter than that of shorter wave length than Hγ. This spectrum is described on page 37.

Ma. III. α Orionis. Enlarged from C 1043, taken February 3, 1888, exposure 101^m. The spectrum is faint at the end of shorter wave length, thus causing the red color of stars of this class. Numerous narrow bright lines or bands are seen. It is difficult to decide whether these are due to an increase in light, or to the absorption of the adjacent dark lines. The light diminishes abruptly at 4762 and 4954. This spectrum is described on page 42, and referred to in Remark 211, page 189.

Some of the spectra described in this Volume are peculiar. Six of them are shown in Plate II. All except the first of them, α Cygni, contain bright lines. The notation according to the Draper Catalogue, modified as described on page 139, is given in the left hand margin, and the name of the star in the right hand margin. A brief description of each spectrum is given below:—

A2F. Pec. α Cygni. Enlarged from C 5929, taken September 2, 1893, exposure 76^m. This spectrum has very narrow lines of well marked intensity. The lines H, and Hε are clearly separated on the original negative, on which, also, the fine lines are more conspicuous than on this reproduction. This spectrum is described on page 26, and in Remark 154, page 186. A list of the lines is given in the sixth column of Table VII.

Oa. Pec. γ Velorum. Enlarged from X 8478, taken April 28, 1897, exposure 99^m. This is the brightest star of the fifth type. The illustration shows the wide bright bands at the approximate wave lengths, 4642 to 4670, and 4682 to 4700, and numerous other bright bands, but in general, the dark lines are not clearly reproduced. This is probably due to the lack of contrast between the hazy dark lines and the continuous spectrum. The wave lengths and intensities of the lines in γ Velorum are given in Table XXVII, and a general description of the spectrum is given on page 247.

Od. ζ Puppis. Enlarged from X 6257, taken December 17, 1894, exposure 34^m. This spectrum is described on pages 148 and 231. The wave lengths and intensities of all the lines, except 3783.4, 4608.2, 5202.2 and 5414 are given in Table XXII. All the lines are dark except the bands 4633 and 4688, approximately, which are bright. The spectrum shows no well marked dark lines except those of the two series of hydrogen.

The constitution of this star appears to be unique. No other spectrum has yet been found in which the second series of hydrogen lines is so well shown. A comparison with the spectrum of α Cygni shows which lines belong to the ordinary series of hydrogen. Between the adjacent known hydrogen lines, and somewhat nearer the lines of shorter wave length, the additional lines appear. These belong to the second series.

B. Pec. γ Cassiopeiæ. Enlarged from C 5189, taken November 23, 1892, exposure 50^m. The spectrum is described in Remark 162, page 100. The presence of both bright and dark lines in this spectrum is shown in the illustration, and also the varying intensity of the different bright and dark lines of hydrogen. The line Hβ is bright, dark edges being faintly perceptible in the original negative. The dark line Hγ is broader than the bright line Hγ, and therefore appears on each side of it. The dark Hδ is as conspicuous as the bright Hδ, and the double reversal described in Remark 162, Part I, is visible in the reproduction. The bright Hε is but faintly seen, even in the original negative, while the dark Hε is strongly marked. Thus in the successive lines, the dark lines progressively increase, and the bright lines diminish, so that in the first the bright line only, and in the last the dark line only is conspicuous.

In the translation, by Professor Frost, of Professor Scheiner's work, Die Spectralanalyse der Gestirne, page viii, the statement appears "Professor Scheiner does not believe it possible that dark lines exist in the spectrum of γ Cassiopeiæ, as none have ever been seen in numerous photographs taken at Potsdam." He declined to modify this statement even after he had been shown the Harvard photographs. The dark lines in this star are somewhat wide and hazy and it is perhaps on this account that they have been unable to photograph them with the slit spectroscope at Potsdam. This failure is, however, conclusive evidence of the value of spectra taken with an objective prism for work of this class.

B 2 A. Pec. μ Centauri. Enlarged from X 8362, taken February 8, 1897, exposure 60^m. This spectrum is described in Remark 47, page 178. The relations of the dark and bright portions of the hydrogen lines are shown in the illustration. $H\beta$ is wholly bright, for although very faint dark edges were detected on the original negative, they are too indistinct to show in a reproduction. The decreasing bright central portion and the increasing dark underlying portion of the hydrogen lines from $H\beta$ to $H\epsilon$ may be seen in the illustration.

This spectrum closely resembles that of γ Cassiopeiæ, although some differences are perceptible. It is inserted partly to show that the dark lines cannot be due to defects, as has been claimed. It is impossible that a large number of lines due to defect should appear in the same places in the spectra of different stars.

Md. o Ceti. Enlarged from C 11496, taken October 23, 1898, exposure 120^m. This spectrum is of the third type, with bright hydrogen lines. $H\eta$, $H\zeta$, $H\epsilon$, $H\delta$, $H\gamma$ and $H\beta$ are seen in the illustration. This spectrum is described on page 45, and referred to in Remark 131, page 98.

In view of the conspicuous character of the bright hydrogen lines in the spectrum of this and other variable stars of long period, it is remarkable that for years, the discovery of these objects at Harvard by means of these lines, was vehemently denied.

Many astronomers have the impression that the definition of spectra photographed with objective prisms is not good. The scale of the enlargements in Plates I and II is insufficient to show a large portion of the lines visible in the original negative. Unless proper precautions are taken, spurious lines appear in enlargements made with a moving plate or cylindrical lens, which are not readily distinguished from true stellar lines. To show the character of the original negatives, portions of three of them have been enlarged 8.5 times, with the results shown in Plate III. The entire spectrum, on this scale, would be about two metres in length, and accordingly, only the portion from 3910 to 4110 is shown. The three conspicuous lines are K, Hϵ and Hδ. The scale of these enlargements is very nearly that of Angström's charts, or one ten millionth. Comparing these spectra with those of the Sun, it will be seen that we can now obtain photographs of the spectra of the stars which are fairly comparable with those of the Sun taken thirty years ago. The excellent photograph of the normal solar spectrum, taken by Dr. Henry Draper, was published in December, 1872, and was apparently the best photograph of this object published up to that time. A brief description of the three spectra shown in Plate III is given below.

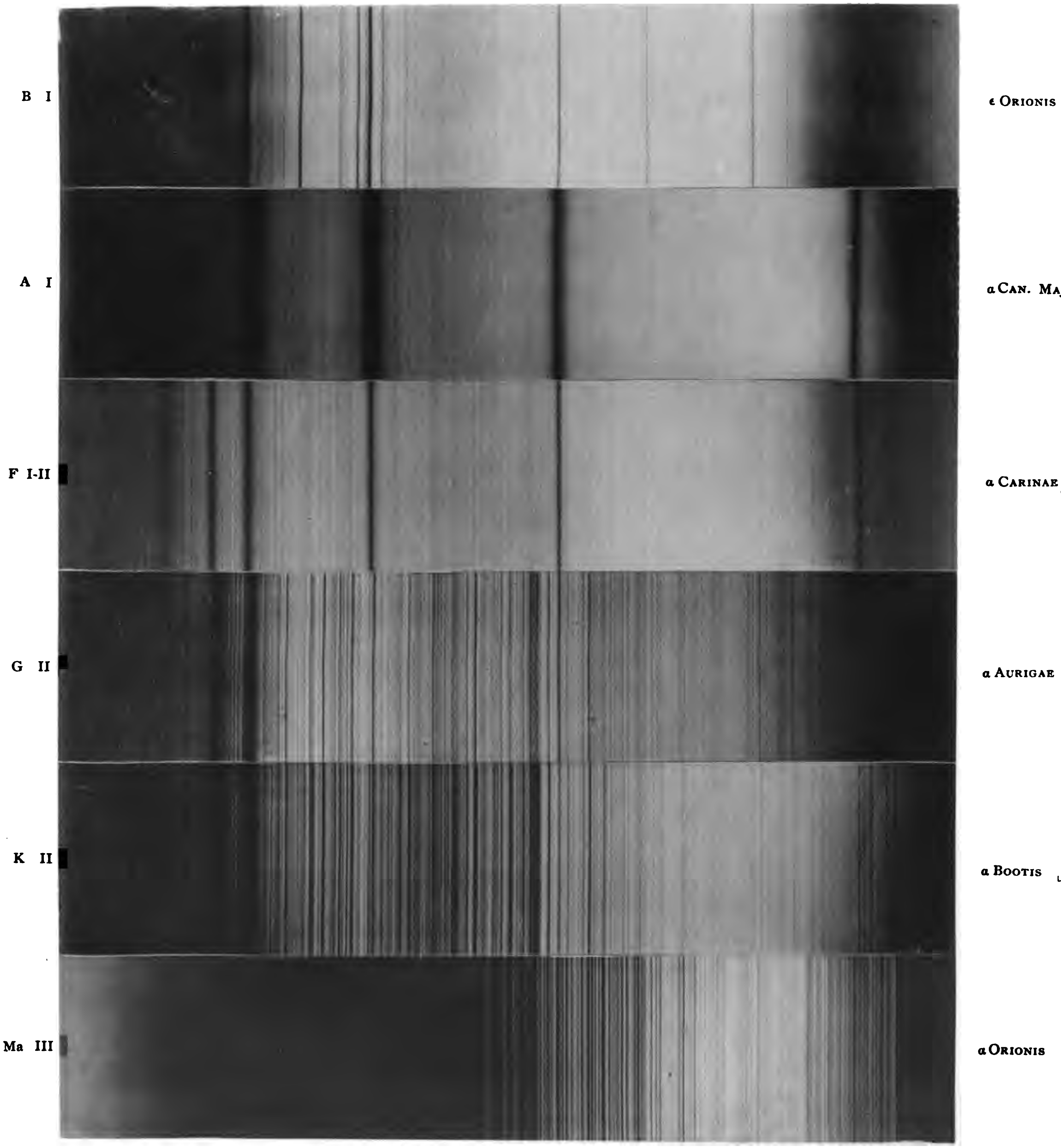
B. I. β Orionis. Enlarged from X 8096, taken October 31, 1896, exposure 60^m. The lines visible, commencing from the left, are 3918.7, 3920.6, 3926.8, K, 3964.6, H, Hϵ, 3994.9, 4009.5, 4026.4, 4075.9, and Hδ. The separation of the calcium line H from the hydrogen line Hϵ, is clearly seen.

A. I. α Canis Majoris. Enlarged from X 8094, taken October 28, 1896, exposure 60^m. This is the same photograph as that used in Plate I. The calcium line H is well separated from the hydrogen line, Hϵ. In the original negative, 14 fine lines can be counted between Hζ and K, 7 between K and H, and 23 between Hϵ and Hδ.

F. I–II. α Carinæ. Enlarged from X 8114, taken November 9, 1896, exposure 82^m. This is the same photograph as that used in Plate I. As compared with α Canis Majoris, a large increase in the number and intensity of the solar lines, and in the intensity of the line K, is seen. The line K is approximately as intense as Hϵ. In the original negative, 21 lines are counted between Hζ and K, 16 between K and Hϵ, and 48 between Hϵ and Hδ.

END OF VOLUME XXVIII.

PLATE I.



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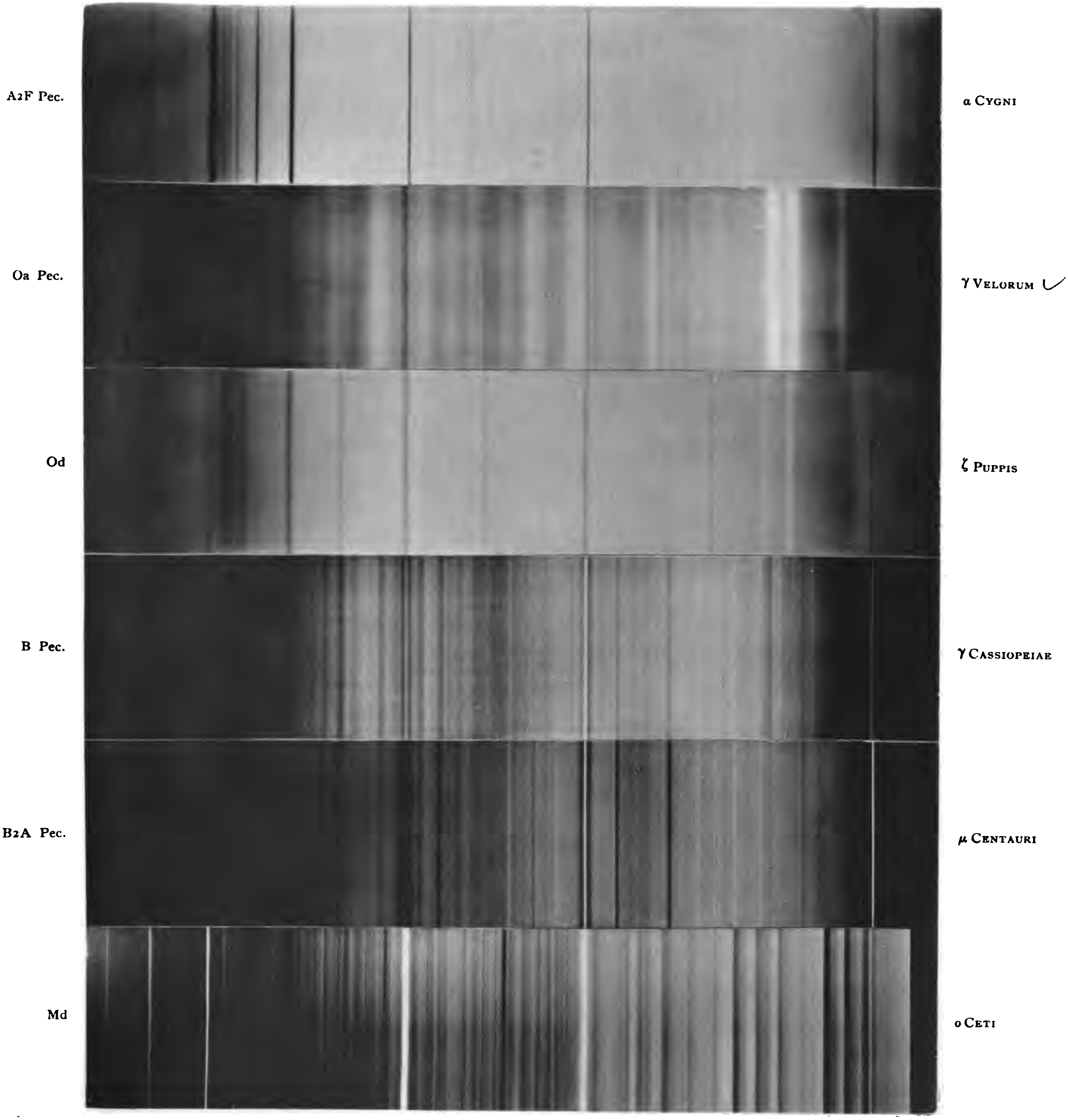
TYPICAL SPECTRA.

PLATE II.



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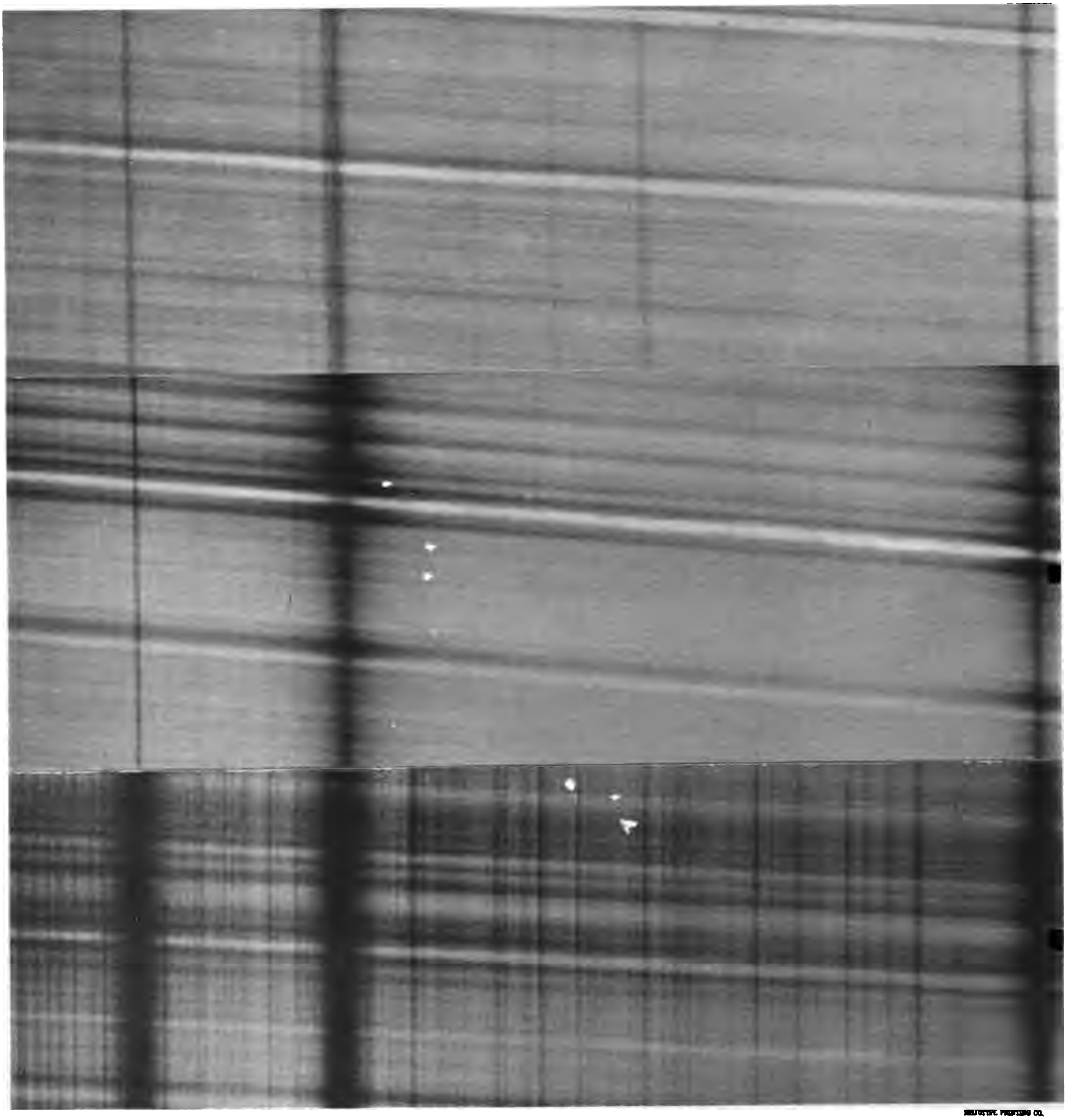
PECULIAR SPECTRA.

PLATE III.



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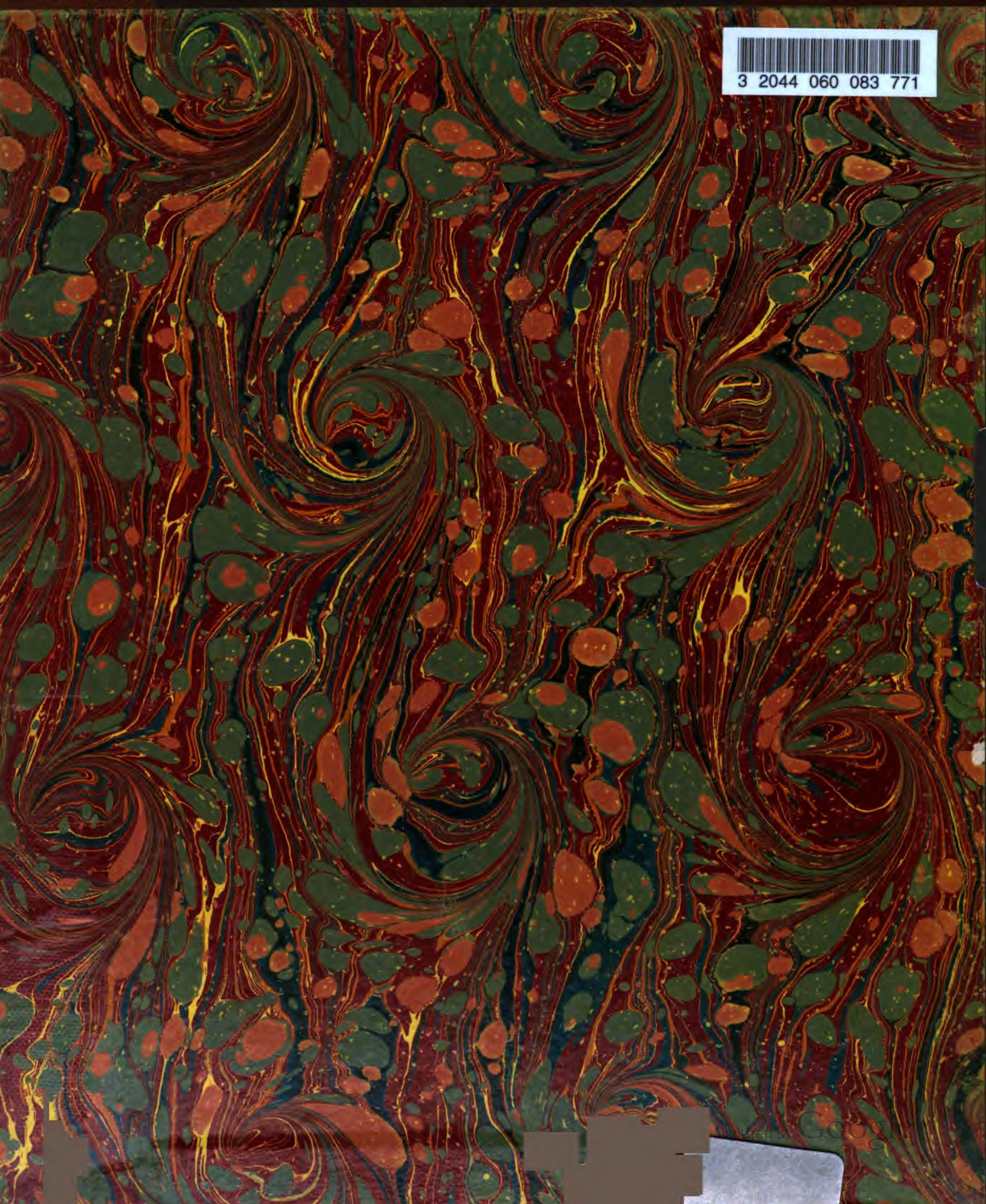

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